



**US Army Corps
of Engineers**
Huntington District

Ohio River Navigation System Report, 1996

Commerce on the Ohio River and its Tributaries



**U.S. Army Corps of Engineers
Ohio River Division**

Foreword

The Ohio River System (ORS) is an indispensable network of commerce that benefits a wide spectrum of commercial, industrial and agricultural users. Cargo shipped on the ORS originates or terminates in more than 20 states and a number of foreign countries. The navigable rivers which comprise the ORS have long been transportation arteries. Locks and dams were first constructed on the Monongahela, Allegheny and upper Ohio Rivers, driven by the transportation needs of a newly-formed steel industry. In the mid-19th Century, states and private companies made improvements to a number of rivers including the Allegheny, Green and Kanawha. Improvements to the Tennessee and Cumberland rivers were accomplished by the federal government with the intention of strengthening river valley economies. Subsequent modernization investments secured the Ohio River System's role as an efficient, economical and reliable provider of bulk transportation opportunities.

As the nation's steward of this system, the Corps of Engineers takes pride in the planning, engineering, construction and operation of the 60 locks and dams in the system. Shippers and consumers realize over \$2.2 billion annually in savings as a result of using the waterways of the Ohio River System over more costly modes of transportation. These benefits are not provided by individual projects, but through their functioning as an integrated transportation system. Like any transportation system, portions may deteriorate with time or become outmoded in the face of advancing technologies. Lock and dam facilities are no exceptions. As a project becomes less reliable due to age or a congestion point because of inadequate capacity, the overall efficiency of the system diminishes. Therefore, the Corps' job is twofold: to operate existing projects at their highest level

of efficiency and to plan for tomorrow's needs thereby maximizing benefits to the nation from waterway use.

The recognized importance of the system is evidenced by the number of projects that have recently been modernized or are in the process of being improved. For example, Gallipolis Locks and Dam, one of the first high-lift dams on the Ohio River, had its two original chambers replaced with 1200' X 110' and 600' X 110' locks in a bend-straightening canal. Along with the new locks, the project gained a new name, the Robert C. Byrd Locks and Dam. On the Monongahela River, a new 720' X 84' lock at Point Marion replaced the old 360' X 56' L/D 8 in October 1994, and the new lock and dam project at Grays Landing replaced L/D 7 in November of 1995. Additional locks that are either being rehabilitated or replaced: new locks are under construction at Winfield on the Kanawha River, and the new locks and dam at Olmsted will replace L/Ds 52 and 53 on the lower Ohio River. Other locks have been authorized for improvement, these include the McAlpine Locks on the Ohio River and the improvements of the Monongahela River Locks and Dams 2, 3 and 4 authorized by the Water Resources Development Acts (WRDA) of 1990 and 1992, respectively. These authorized projects are currently in the pre-construction engineering and design phase of modernization. Feasibility studies have been completed on the modernization of the Kentucky Lock on the Tennessee River and the Marmet Locks on the Kanawha River, and these projects have received congressional authorization. The Corps is currently conducting feasibility studies for the Ohio River main stem involving 19 lock and dam projects and for London Locks on the Kanawha River.

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This Ohio River Navigation System Report provides information about the Ohio River Navigation System and its commerce. The 1996 edition was prepared, published and distributed by the Ohio River Division's (ORD) Navigation Planning Center, located in the Huntington District of the US Army Corps of Engineers.

The 1996 Ohio River Navigation System Report is organized into seven sections. Part 1 describes the sources of the data used in this publication and explains its aggregation into commodity groups. Part 2 offers an overview of the continental US inland waterways, a review of the inland waterway industry, a description of both the Mississippi and Ohio river systems and historical commodity data on the navigable rivers which comprise the Ohio River Navigation System. Part 3 discusses the state of the system and describes the partners with which, and the process by which, waterway improvements are achieved. The impact of the Ohio River Navigation System on the regional economy and 1994 basin commerce is presented in Part 4. Project statistics for 1995 and state and port commerce for 1994 are presented in Parts 5 and 6, respectively. The report concludes with Part 7, a listing of other waterway data publications.

The waterway data in this report are made available in response to frequent requests for this type of information from Ohio River Basin shippers, port authorities, state and local government agencies, regional waterway transportation agencies, and others.

PART 1

Waterborne Commercial Data

The Databases

This report contains commercial waterborne traffic data derived from Corps of Engineers databases. The databases are of two types and involve two different collection and processing procedures. They are the Waterborne Commerce Statistics and the Lock Performance Monitoring System.

Waterborne Commerce Statistics are collected from the waterway users and are processed by the Corps' Waterborne Commerce Statistics Center (WCSC) in New Orleans. The data, provided by waterway vessel operators as required by law, contain detailed information on

vessel movements, including commodity tonnage and the origin and destination points. Monthly reports are accumulated throughout the year, followed by roughly one year of data processing. Consequently, processing has not yet been completed on 1995 data and the latest available WCSC information is for 1994.

The Lock Performance Monitoring System (LPMS) collects information regarding the performance of the navigation locks, such as the number of lockages, delays, tonnages, and other lock related statistics. The information is collected during the lockage by lock operators and processed by the managing district office. Each district then submits their information to the Navigation Data Center (NDC) on a monthly basis. The data are then placed in a central library containing data on all Corps navigation projects. The most recent full year of LPMS data available is for 1995.

Table 1
Ohio River System Commodity Classification

Commodity Group		1992 WCSC Commodity Codes	LPMS Commodity Codes
1	Coal & Coke	32100	10
2	Petroleum Fuels	33300, 33411-33450, 34000	20-29
3	Aggregates	27310-27350*, 29115	43,45,48
4	Grains	4100-8190**, 22220	60,62-65,67
5	Chemicals	33521-33525, 51113-59990	30-32
6	Ores & Minerals	27323, 27820-27910, 28500-28790#	46,47
7	Iron & Steel	28100-28200, 67090-67900	44,53
8	Other	3500, 6110, 6150, 27862	24,40-42,49,50-52
		27869, 29299, 32500, 33429	54-55,59,61,66
		33510, 33530, 33540, 33590, 27920	68,70,90,99
		28800, 29220, 22230-22390	
		24610-25090,41130-42000	
		63400-66330, >68299	
* excludes 27323			
** excludes 6110,6150			
# excludes 27862,27869			

Commodity Group Classification

For statistical reporting and record keeping purposes, the ORD Navigation Planning Center (NC) groups commodities shipped on the Ohio River System into eight major categories. Specific WCSC and LPMS commodity codes and the commodity group in which they belong are displayed in Table 1. The names of the commodities within each group are listed below.

Coal & Coke: coal, lignite, and coke (coal & petroleum).

Petroleum Fuels: crude petroleum; gasoline, including additives; jet fuel; kerosene; distillate and residual fuel oil; and liquefied petroleum, coal and natural gases.

Aggregates: marine shells, limestone flux, calcareous stone, sand, gravel and crushed rock.

Grains: barley and rye, corn, oats, sorghum grains, wheat and soybeans.

Chemicals: sodium hydroxide; crude products from coal tar, petroleum and natural gas; alcohols; benzene and toluene; sulfuric acid; basic chemicals and products; plastic materials; soap; and inorganic fertilizers.

Ores & Minerals: bauxite, manganese and nonferrous metal ores, clay, salt, liquid sulfur, gypsum and nonmetallic minerals.

Iron & Steel: iron ore; pig iron; iron and steel ingots, bars, plates, sheets and pipes; ferroalloys; and iron and steel scrap.

Other: oilseeds; animals and animal products; phosphate rock; tallow, animal fats and oils; animal feeds; grain mill products; sugar and

molasses; vegetable oils; logs, woodchips, staves and moldings; charcoals; paper and paperboard; lubricating oils and greases; naphtha, mineral spirits and solvents; asphalt, tar and pitches; building cement; lime; slag; machinery; recreational vehicles; frozen vegetables; and government materials.

PART 2

The Inland Waterway System

Overview

The United States has 25,777 miles of navigable inland channel, including the commercially important Atlantic and Gulf Intracoastal waterways, the Mississippi River System, the Pacific Coast waterways, and the Great Lakes waterways (see Table 2 and Figure 1).

Table 2
U.S. Navigable Channels

Waterway	Miles
Atlantic Coast Waterways	7,002
Gulf Coast Waterways	5,663
Mississippi River System	8,954
Pacific Coast Waterways	3,575
Great Lakes Waterways	590
Other Waterways	93
Total	25,777

Overall about 75 percent of this channel mileage is at least six feet deep, and about 62 percent of this channel mileage is at least nine feet deep. The Federal Government improves and maintains almost 11,000 miles, or 43 percent, of the total channel length. Improvements include navigation structures such as locks and dams, river training devices (dikes, revetments and groins), and dredging.

Figure 1
Continental U.S. Waterway Systems

Navigation on the Mississippi River below St. Louis and on the Missouri River system is referred to as open river design, that is, without locks and dams. This method does not require massive investments in locks and dams and allows tows to move unimpeded. Navigation on most commercially navigable streams is made possible by a series of locks and dams which create navigable pools. Locks are the means by which river traffic is passed through the dams from one pool-level to the other. The Atlantic and Gulf Intracoastal waterways were designed through combinations of these methods because of tidal currents and strong winds.

The inland waterway system offers low transportation rates for movement of bulk commodities such as coal, aggregates, chemicals, petroleum fuels, grains, iron

and steel, and ores and minerals. In 1994, almost 1.1 billion tons of domestic waterborne commerce moved on the U.S. waterway system. Over 55 percent of this tonnage consisted of internal movements, wherein, origin and destination took place entirely within the inland waterways. From 1980 to 1994, internal domestic traffic on the waterways increased from 535 million tons to 618 million tons. Of the 1994 internal traffic, nearly 30 percent consisted of coal. Petroleum, the nation's largest bulk import commodity, and petroleum products accounted for about 26 percent. The nation's largest export commodity, grain, amounted to almost 8 percent.

The U.S. Army Corps of Engineers is responsible for managing the nation's waterways and harbors. This includes the planning, develop-

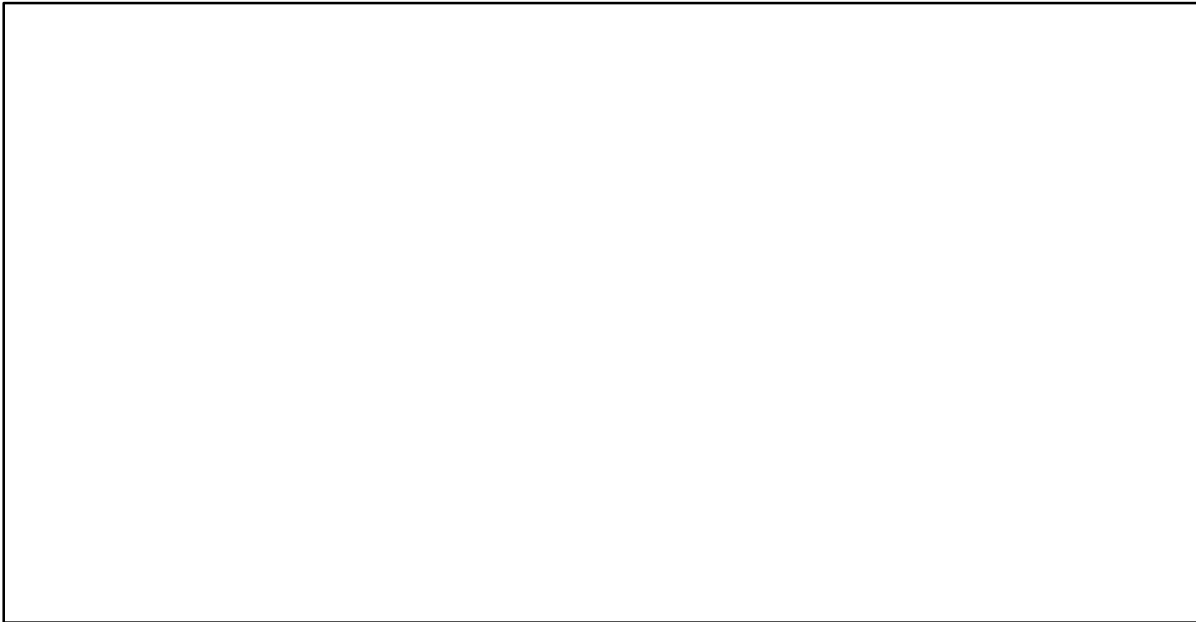


Photo 1: Ohio River Tow

ment, maintenance and operation of the nations' waterways and harbors. The U.S. Coast Guard manages the safe use of these waters. Both agencies work closely with the towing industry to fulfill these responsibilities. The inland waterway transportation industry involves public and private interaction between commercial fleets of towboats and barges, wharves and other waterfront facilities, and the waterway navigation projects built and maintained by the Corps.

The Inland Waterway Industry

Industries utilizing the inland waterways include electric power, steel, chemical, oil and gasoline refining, and agriculture. They rely on the availability of low cost waterway transportation for the movement of large volumes of bulk commodities. Transportation savings realized by industry are passed on to the public in lower costs for goods and services. In 1994, approximately 1,193 towing companies with 2,779 individual towboats and over 26,400 barges were in operation on the inland waterway system. High horsepower towboats of 5,600-10,500

horsepower move the larger tows on relatively broad reaches of the lower Mississippi and Ohio rivers. A typical Ohio River towboat is 4,500 horsepower, while on its tributaries a towboat averages about 2,000 horsepower. Tow size increases with the larger towboats, enhancing the efficiency of the waterway fleet. Since the late 1950s, the waterway industry has gained efficiency through larger barges and increased tow size, while average horsepower has more than tripled.

The number of barges in a tow range from 4 to 30, with the typical Ohio River tow consisting of 15 barges. Three barge types common to the Ohio River include: open hopper, covered hopper, and tanker. Figure 2 displays the dimensions and capacities of these barge types. Open hopper barges provide nearly 50 percent of the tonnage capacity on the waterway system and are used for all types of bulk, solid cargo. Covered hopper and tanker barges each provide about 25 percent of system tonnage capacity.

Barge hulls are shaped to facilitate their assembly into tows that provide an efficient

underwater configuration, similar to that of a single vessel. The leading barges in a tow usually have raked bows to reduce drag and the other barges have squared bows for a tight configuration.

Lower energy costs provide the barge industry a rate advantage over truck and rail. The lower unit cost associated with increased waterborne tonnage makes barge transportation economically attractive. Barge lines transport about 13 percent of (national) inter-city commerce at about one percent of the total shipping cost. No other mode of transportation is as amenable to the movement of massive amounts of bulk commodities. Furthermore, barge transpor-

tation is the most energy efficient mode for carrying large quantities of bulk commodities. For example, a typical barge can carry as much coal or grain as 15 rail cars for a little more than one-fourth the energy per ton-mile. The capacity of a jumbo barge is compared with other transportation modes in Figure 3.

The low freight rates of barge traffic help hold down the rates of competing railroad and truck lines. A strict comparison between alternate modes of transportation is difficult because within each mode the same commodity will move at different rates. However, barge rates are, on average, lower than either truck or rail rates. Recent Corps of Engineers' transportation rate studies have found that the cost savings associated with waterway commerce varies depending on the commodity hauled, the alternate mode, the value of the movement, and the length of the haul. However as a general rule, barge rates are about 30 percent of rail rates. This is not to say that rail and trucking firms do not benefit from the waterway system, for they are, in effect, a part of it. In the Ohio River Basin (ORB), for example, about 75 percent of waterborne coal reaches the barge loading terminals by rail or by truck.

The Mississippi River System

Of the 8,954 miles making up the Mississippi River System, approximately 5,966 miles have been improved and are maintained at a minimum depth of nine feet. The main stem Mississippi River from St. Paul to the Gulf is about 1,837 miles long. The rest of the system's mileage is made up of major tributary navigation systems such as the Ohio, Arkansas, Illinois, and Missouri rivers. Distances between major shipping points on the Mississippi River System are presented in Figure 4.

Figure 2
Common Barge Types

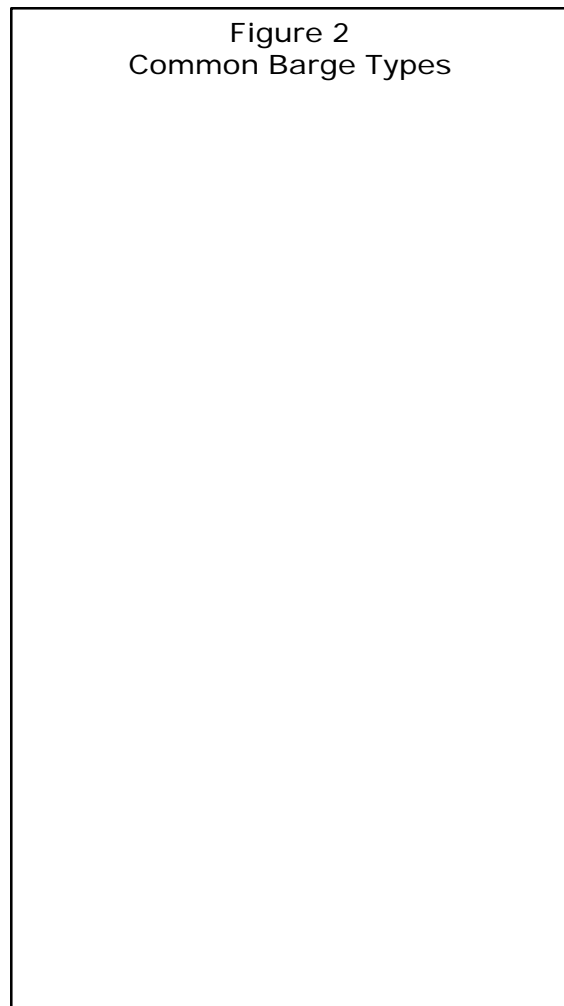




Photo 2: Coal Tow

Navigation on this system has been improved through modernization programs. Rehabilitation or replacement of worn, capacity restricting projects is a continuing process. Some of the more significant improvement works underway or recently completed are discussed in the following paragraphs.

- Fifteen projects on the upper Mississippi have been rehabilitated in the last twelve years. One project, L/D 26, had both chambers replaced by 1992. The new main chamber measures 1200' by 110' and the new auxiliary measures 600' by 110'.

- Since 1953 seventeen new projects have been constructed on the Ohio River mainstem: sixteen have a main chamber measuring 1200' by 110' and an auxiliary chamber measuring at least 600' by 110', one has twin 1200' by 110' chambers. Another project, R.C. Byrd Locks and Dam, opened two new chambers (1200' by 110' and 600' by 110') and is undergoing major rehabilitation of its original

dam. Large locks have been constructed at all but the three uppermost Ohio River sites: Emsworth, Dashields and Montgomery. These three projects underwent major rehabilitation from 1984 to 1990. On the lower Ohio (near Olmsted, Illinois) a high lift dam with twin 1200' by 110' locks will replace an old low-lift, wicket structure at Locks and Dams 52 and 53. The Olmsted project was authorized in the Water Resources Development Act of 1988 and construction began in October 1992. Olmsted L/D is scheduled to be operational by the year 2006.

- The current Kanawha River Navigation System consists of three high-lift structures. Each of the three structures has twin 360' by 56' lock chambers. Modernization of the Kanawha River began in 1990 when construction of a new 800' by 110' lock at Winfield Locks was initiated. The Corps is recommending a similar plan for Marmet Locks.

- Modernization of the Monongahela River started in 1953 with the completion

of the Morgantown L/D. Since then locks at Hilderbrand, Maxwell, Opekiska, Point Marion, and Grays Landing have been constructed. The new 720' by 84' Point Marion Lock opened to navigation in 1993. The new 720' by 84' lock at Grays Landing was opened in July of 1995 to replace L/D 7. Modernization of lower Monongahela projects has only just begun. Planned improvements on the lower Monongahela include a new gated dam at L/D 2; removal of Lock and Dam 3; and new twin 720' by 84' locks at L/D 4.

- The original Warrior-Tombigbee River System was completed in 1915. A modernization program to replace the original 17 locks and dams with six new locks and dams were initiated in 1937 and completed in 1980 when the high-lift Bankhead Lock and Dam became operational.

- The Tennessee-Tombigbee Waterway adds 234 miles to the Mississippi River System. It connects the Tennessee River and the Black Warrior River through a system of 10 locks and dams. Construction began in 1972 and was sufficiently complete to open the wa-

Figure 3
Alternate Transportation Mode Comparison

terway to traffic in January 1985. This system provides a more direct route between the lower Ohio River and the Gulf of Mexico at Mobile, Alabama.

- The McClellan-Kerr-Arkansas River Navigation System consists of 17 locks and dams. The 15 projects on the Arkansas River and the two on the Verdigris River are supported by seven tributary reservoirs to maintain adequate navigation. This system provides an additional 448 miles of navigable channel from the Mississippi River to Tulsa, Oklahoma. The nine foot deep channel was opened in 1971.

In 1981, work was completed on the Missouri River channel to increase its year-round navigable depth from seven to nine feet. This was accomplished through open river construction which utilized stone berms and revetments to force the stream into a deeper, more narrow channel.

The Ohio River Navigation System

The Ohio River Navigation System (ORS) is a vital transportation network situated in the

Ohio River Basin (ORB). The ORB is a 204,000 square mile area, drained by the Ohio River and its tributaries, which includes portions of 14 states (see Figure 5). The topography of the basin varies from rugged mountains to flat plains. The eastern portion is dominated by the Appalachian Mountains. West of these mountains and south of the Ohio River, the landscape contains considerable local relief, which gradually modifies to rolling plains through most of Kentucky and Tennessee. North of the Ohio River, broad valleys with only minor relief extend from southwestern and central Ohio through central Indiana into southern Illinois.

The Ohio River and its tributaries perform a wide variety of natural and man-made functions. The ORS was constructed to maintain navigation during the low water season when water transportation historically came to a halt. The existing system of tributary reservoirs provides storage for many purposes, one of which is to maintain low flows in the tributaries during periods of drought. During the drought of 1988, reservoir releases increased the flows of the Ohio River at Cincinnati by 40 percent and

Photo 3: Coal Train

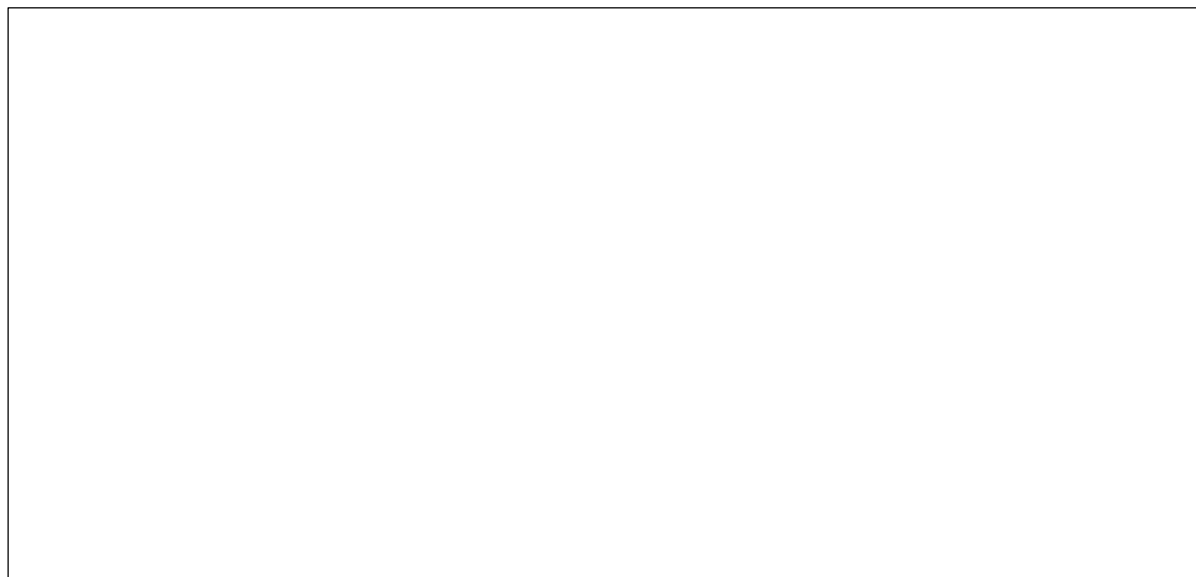


Figure 4
Waterway Distances on the Mississippi River System

enabled the Corps to maintain navigation on the lower Ohio River. During this same period, flows on the Mississippi River dropped to levels that adversely affected navigation. The pools formed by the many navigation dams provide a contiguous water surface over the entire length of the waterway. Unlike tributary storage reservoirs, navigation structures do not contain flood control storage. The year-round availability of a dependable water supply from these navigation pools has contributed significantly to the development and well-being of most riverside municipalities and industries. The pools are used

for a number of purposes besides navigation, including recreational boating, fishing, water supply and cooling for power plants.

The ORS consists of the Ohio River and its navigable tributaries: the Kanawha, Monongahela, Allegheny, Green, Cumberland, Tennessee, Big Sandy, and Kentucky rivers, and numerous navigable slackwater tributary streams. The Ohio River and most of its navigable tributaries are maintained at a minimum depth of nine feet by a system of locks and dams and channel improvements (see Table 3).

The Ohio River and its navigable tributaries provide a 2,400 mile economic life-line that has shown dramatic traffic growth in recent years, moving almost 267.0 million tons in 1994. This traffic accounted for over 43 percent of the nation's total internal waterway freight tonnage in 1994.

Waterborne commerce on the ORS reflects the basin's energy and farm-oriented economy. Two-thirds of Ohio River traffic consist of bulk forms of energy fuels: coal, crude oil, and petroleum products. Other major commodities transported include sand, gravel, chemicals, and grain. ORS waterborne commerce by river, from 1984 to 1994, is presented in Table 4. Historic system traffic by commodity group is presented in Table 5.

Table 3
Ohio River Navigation System

River	Ohio River Mile Location	No. of Projects	River Length (Miles)	Channel Depth
Ohio	-	20	981.0	9.0
Monongahela	0.0	9	128.7	9.0
Allegheny	0.0	8	72.0	9.0
Kanawha	185.3	3	90.6	9.0
Big Sandy	317.0	0	8.6	9.0
Kentucky	470.2	4	82.2	6.0
Green	784.2	2	103.0	9.0
Cumberland	920.4	4	381.0	9.0
Tennessee	934.5	10	652.0	9.0

ORS traffic, led by coal, grew at an annual rate of three percent during the period 1984-1994. Two major coal fields are located within the ORB (the Appalachian Region and the Illinois Basin). Figure 6 shows the location of these

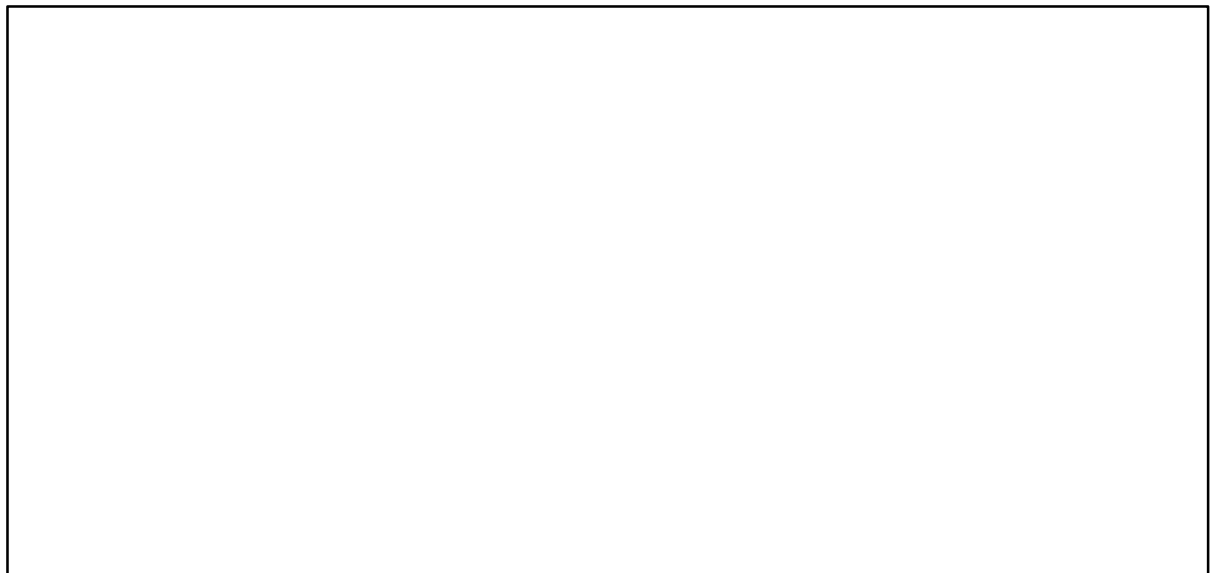
Table 4
Historic ORS Waterborne Commerce by River
(Million Tons)

Waterway	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	Av. Ann. Rate of Increase
Ohio River	174.7	177.5	195.6	197.2	192.6	203.7	225.7	219.4	227.5	228.4	238.1	3%
Kanawha River	14.2	14.6	18.2	16.2	17.8	18.7	20.9	21.6	21.8	22.3	22.3	5%
Monongahela River	34.5	28.8	32.4	32.9	37.2	38.4	37.8	33.9	37.4	33.4	36.9	1%
Allegheny River	4.3	3.9	3.5	3.9	3.3	3.2	3.6	3.0	3.4	3.1	3.2	-3%
Green River	11.4	11.1	9.2	9.5	7.8	8.2	10.8	10.2	9.3	7.8	7.8	-4%
Cumberland River	14.1	14.2	22.6	15.3	14.0	13.3	13.7	14.1	16.2	14.3	14.4	0%
Tennessee River	33.2	36.4	42.1	41.5	46.2	42.7	44.7	42.0	45.9	48.1	48.7	4%
Barkley Canal	4.7	6.8	12.8	7.5	8.0	6.7	7.8	8.8	9.9	8.0	8.7	6%
Big Sandy River	8.4	9.6	10.3	11.3	12.5	16.1	20.3	20.6	22.4	23.5	22.2	17%
Little Kanawha River	0.4	0.5	0.5	0.6	0.6	0.4	0.4	0.4	0.5	0.3	0.2	-7%
Kentucky River	0.2	0.2	0.2	0.1	0.2	0.2	0.2	0.2	0.3	0.3	0.3	4%
Clinch River	0.1	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	N/A
Hiwassee River	0.8	0.9	1.0	1.0	1.0	0.9	0.9	1.0	0.9	0.8	0.8	0%
Ohio River System	202.2	203.9	222.2	226.7	225.9	238.4	257.8	248.9	257.7	253.1	267.0	3%

Source: WCSC Data

Figure 5
Navigable Rivers in the Ohio River Basin

Photo 4: Smithland Locks and Dam



reserves. The Ohio, Monongahela, Kanawha and Big Sandy rivers are principal routes for Appalachian coal, the Green and Ohio rivers for Illinois Basin coal. These waterways provide a natural advantage to waterside coal mines.

Coal production in the Appalachian region of the U.S. has averaged about 48 percent of total U.S. coal production for the last 10 years. In 1994, the Appalachian region produced over 445 million short tons of coal, about 43 percent of total U.S. coal production that year. Almost 36 percent of Appalachian coal is shipped by waterway, 41 percent by rail, 14 percent by truck, and 6 percent by conveyor/slurry. Illinois Basin coal also transits the ORS and supplies many of the numerous coal consuming cement, steel and power plants situated along the ORS.

Current projections for coal traffic on the ORS reflect continued growth in export demand, an upturn in domestic steel production, increased domestic electricity demand and an increase in coal's share of electricity generation. The passage of the Clean Air Act Amendments has stimulated production of low-sulfur Appalachian coal and its transportation on the ORS.

Ohio River

The Ohio River is formed by the junction of the Allegheny and Monongahela Rivers at Pittsburgh and flows southwestwardly for 981 miles to join the Mississippi River near Cairo, Illinois. From its beginning, the federal government has been interested in improving transportation on the Ohio River. Official federal involvement in this waterway's improvement began in 1824, when Congress directed the Corps to find a method of removing sandbars and snags. In 1906, the Rivers and Harbor Board recommended the construction of 54 locks and dams to provide a nine foot deep channel over the entire length of the Ohio River. This plan, which called for 600' long lock chambers, was completed by the Corps between 1910 and 1929.

As increased navigation costs began to affect the region's economy, plans were formulated to modernize the river. The primary plan developed called for the replacement of earlier low-lift structures with a smaller number of high-lift locks having longer pools between dams and increased dimensions of the main lock chamber. The modernization program

Table 5
Historic Ohio River System Traffic by Commodity
(Million Tons)

Commodity	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	Av. Ann. Rate of Increase 1984-94
Coal & Coke	123.8	118.8	135.2	137.3	136.7	144.6	161.7	157.0	160.5	149.7	158.6	3%
Petroleum	13.5	12.5	13.5	14.0	13.8	14.2	14.4	13.9	13.4	13.5	14.2	1%
Aggregates	20.9	24.7	28.1	32.2	31.2	33.1	34.7	30.1	31.6	33.6	36.4	6%
Grains	9.5	12.2	10.3	13.0	11.8	14.7	13.6	10.4	11.5	14.2	12.2	3%
Chemicals	13.2	12.9	12.4	12.6	13.3	11.7	9.4	9.8	10.2	10.7	10.7	-2%
Ores & Minerals	3.1	3.6	3.1	2.8	3.2	3.7	5.6	5.8	5.6	6.0	6.6	8%
Iron & Steel	5.0	5.1	5.8	6.0	6.0	6.6	6.6	6.2	5.9	7.3	9.7	7%
Other	13.1	14.1	15.5	8.9	9.8	9.9	11.8	15.6	19.0	18.3	18.6	4%
Total Traffic	174.0	171.2	202.2	203.8	223.9	226.7	225.8	238.4	257.8	248.9	257.7	4.0%

Source: WCSC Data

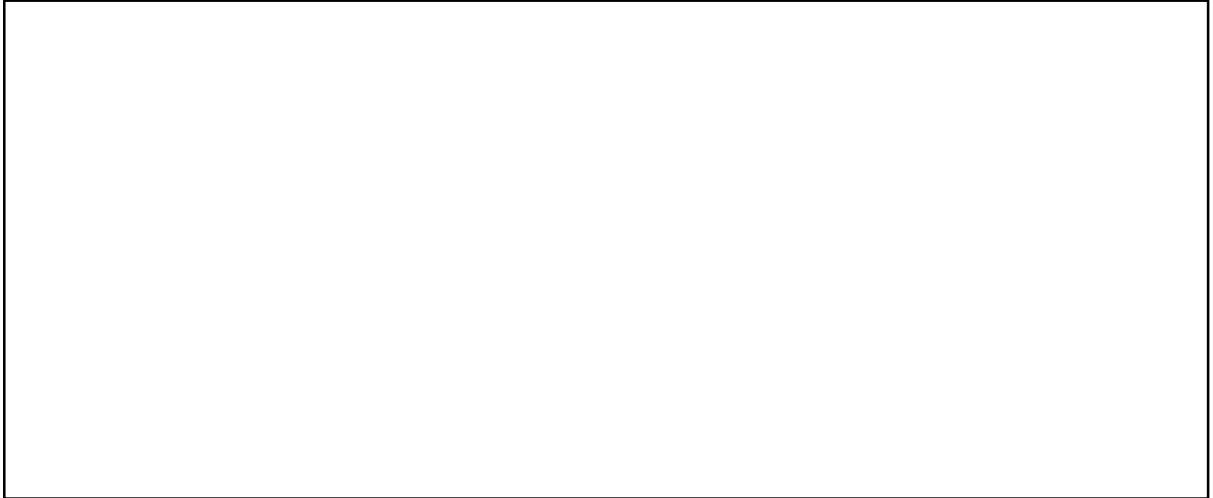


Photo 5: Robert C. Byrd Locks and Dam

began in 1954 with construction of the Greenup L/D, a structure having a 30 foot lift, a 1200' by 110' main lock, and a 600' by 110' auxiliary lock.

The modernization program continues today and envisions 19 modern high-lift lock and dam structures, each having at least one 1200' by 110' lock chamber. Figure 7 shows the plan

**Figure 6
Ohio River Basin Coal Reserves**

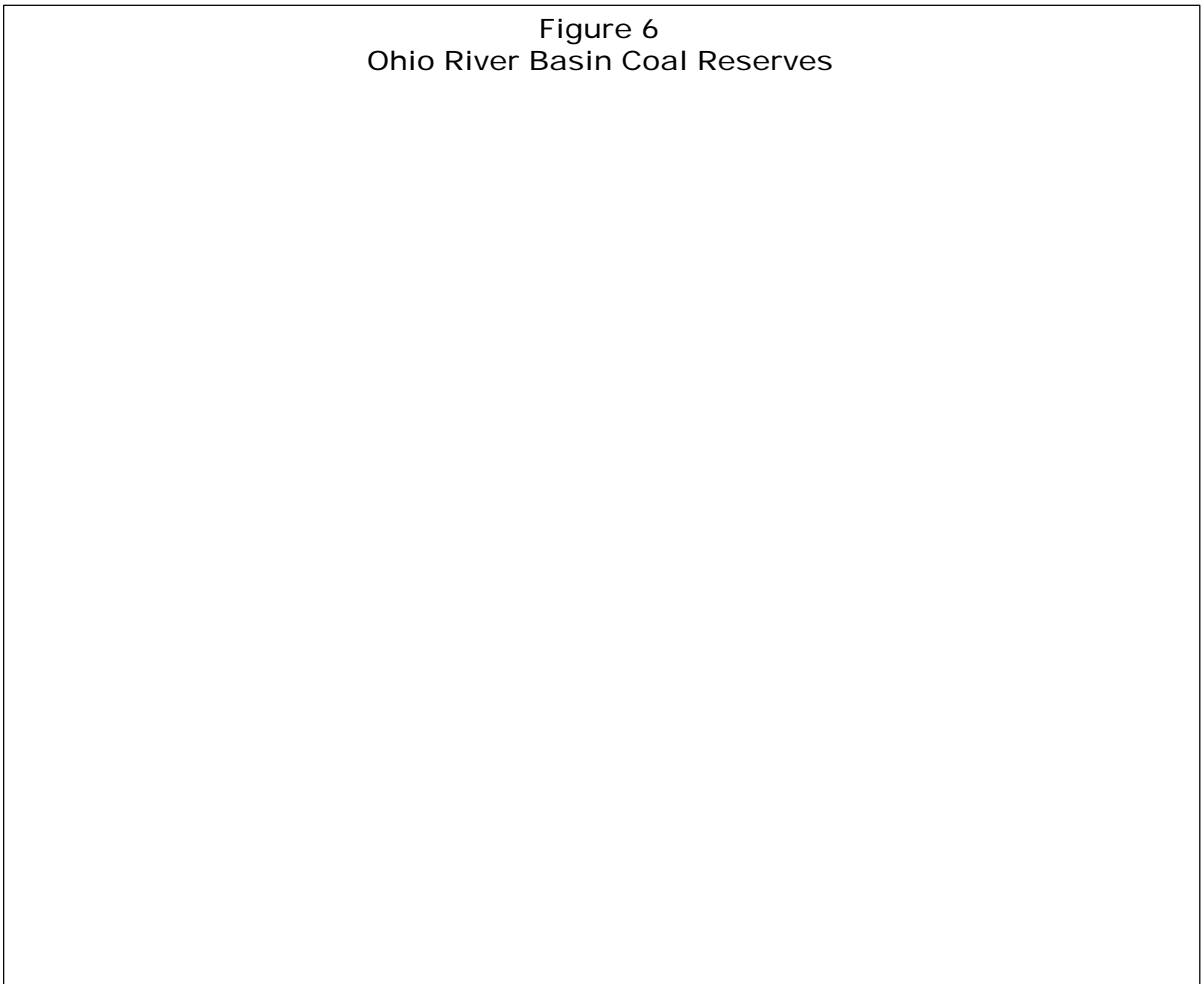
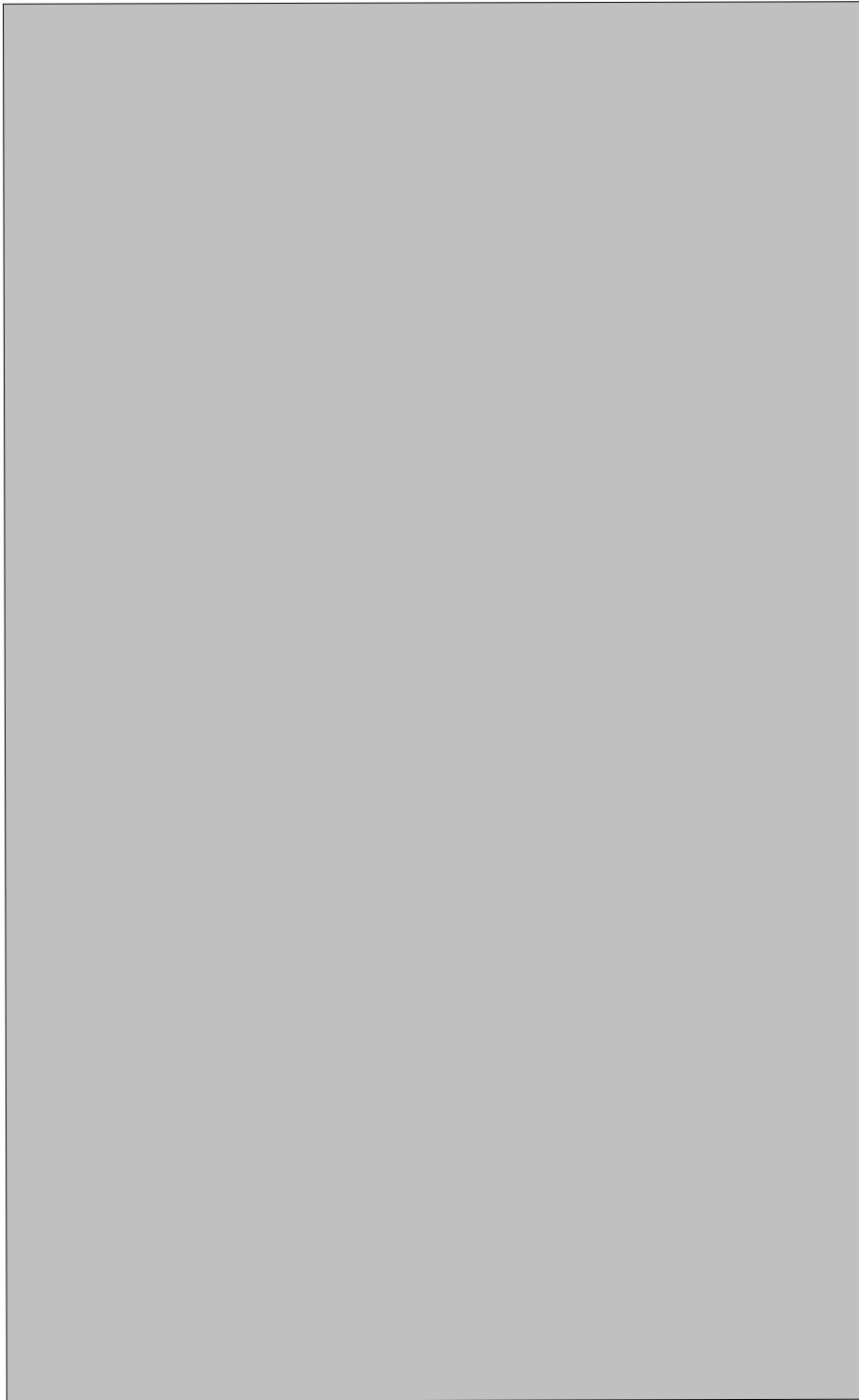


Figure 7
Ohio River Plan and Profile



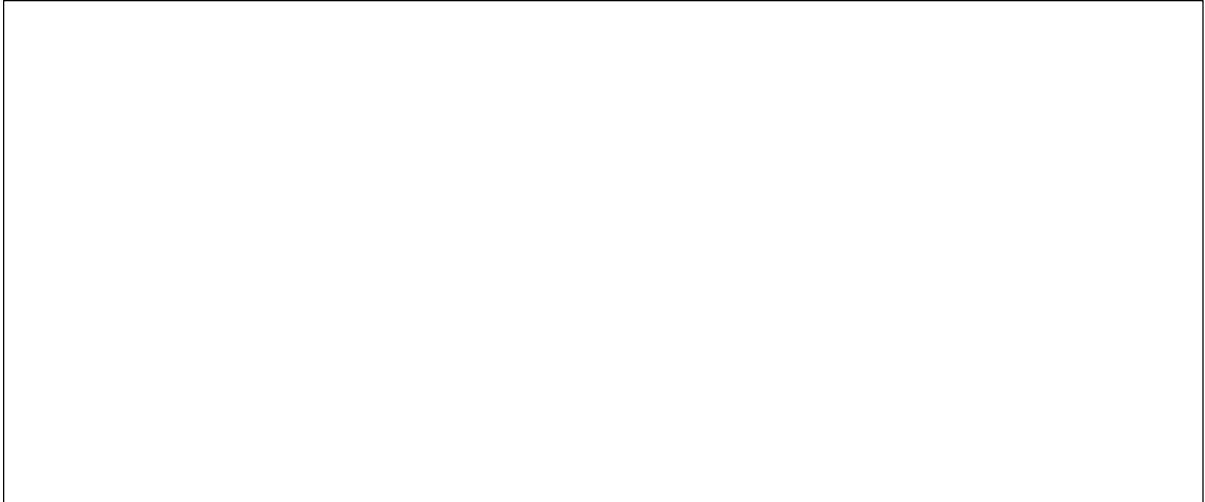


Photo 6: McAlpine Locks and Dam – Ohio River

and profile for the 20 current projects on the Ohio River main stem. Freight on the Ohio River is dominated by coal and aggregates traffic. Table 6 displays historic mainstem Ohio River traffic. The Ohio River has experienced relatively steady growth in traffic since the mid-1960s, with

some decline during the recession of the early 1980s, the drought of 1988, and the 1991 recession. Total tonnage on the Ohio River reached a record 238.1 million tons in 1994, a 48 percent increase over the pre-recession year of 1980.

Table 6
Historic Ohio River Main Stem Traffic
(Million Tons)

Year	Coal	Petro	Aggreg	Grain	Chem	Ores	Iron	Other	Total
1965	46.6	20.5	14.2	2.6	6.0	7.6	3.4	2.3	103.2
1970	59.0	25.3	17.2	3.6	10.6	3.9	4.4	5.5	129.5
1975	73.3	19.6	16.5	4.1	9.1	3.5	3.9	10.1	140.1
1980	86.1	18.3	21.2	6.7	11.5	3.2	4.1	9.6	160.7
1981	94.1	15.2	18.6	8.4	10.8	3.9	4.1	9.4	164.5
1982	87.9	13.3	14.1	11.7	9.1	2.3	2.6	9.7	150.7
1983	85.4	12.7	15.3	9.8	10.7	2.2	3.4	10.9	150.4
1984	102.2	13.5	16.4	9.1	13.1	3.1	5.0	12.4	174.8
1985	98.2	12.5	20.9	11.7	12.7	3.5	5.0	13.4	177.9
1986	112.5	13.4	24.4	10.0	12.2	3.0	5.7	14.8	196.0
1987	114.7	14.0	28.0	12.6	12.4	2.7	5.9	8.2	198.5
1988	110.9	13.8	27.3	11.5	13.1	3.1	6.0	9.1	194.8
1989	115.8	14.1	29.0	14.3	11.6	3.2	6.5	9.3	203.7
1990	135.1	14.4	30.4	13.2	9.3	5.5	6.5	11.2	225.6
1991	131.6	13.9	27.0	10.2	9.7	5.7	6.2	14.8	219.1
1992	135.3	13.3	28.1	11.3	10.1	5.5	5.8	18.1	227.5
1993	130.1	13.4	29.9	14.0	10.5	5.8	7.3	17.5	228.5
1994	134.8	14.2	32.6	12.0	10.6	6.5	9.6	17.8	238.1
Av. Ann. Rate of Increase	4%	-1%	3%	5%	4%	-1%	3%	5%	2%

Source:WCSC Data

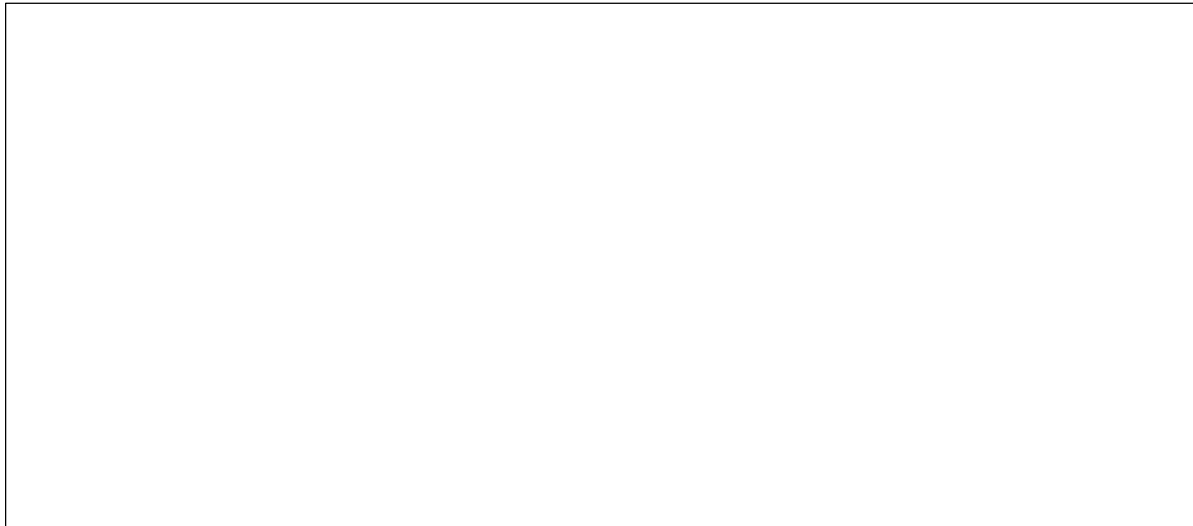


Photo 7: Aerial view of London Locks and Dam–Kanawha River

For the last 10 years, traffic on the Ohio River has grown at an average annual rate of 3 percent. During this period, traffic levels increased for all commodity groups except petroleum products and ores and minerals. Changes in Ohio River traffic levels tend to reflect general national economic cycles. Ohio River traffic dipped dramatically from 1980 to 1983 and dipped again in 1991. The drop in 1988 tonnage resulted from a severe drought that restricted lower Mississippi traffic and slowed Ohio River traffic (see Table 6).

Kanawha River

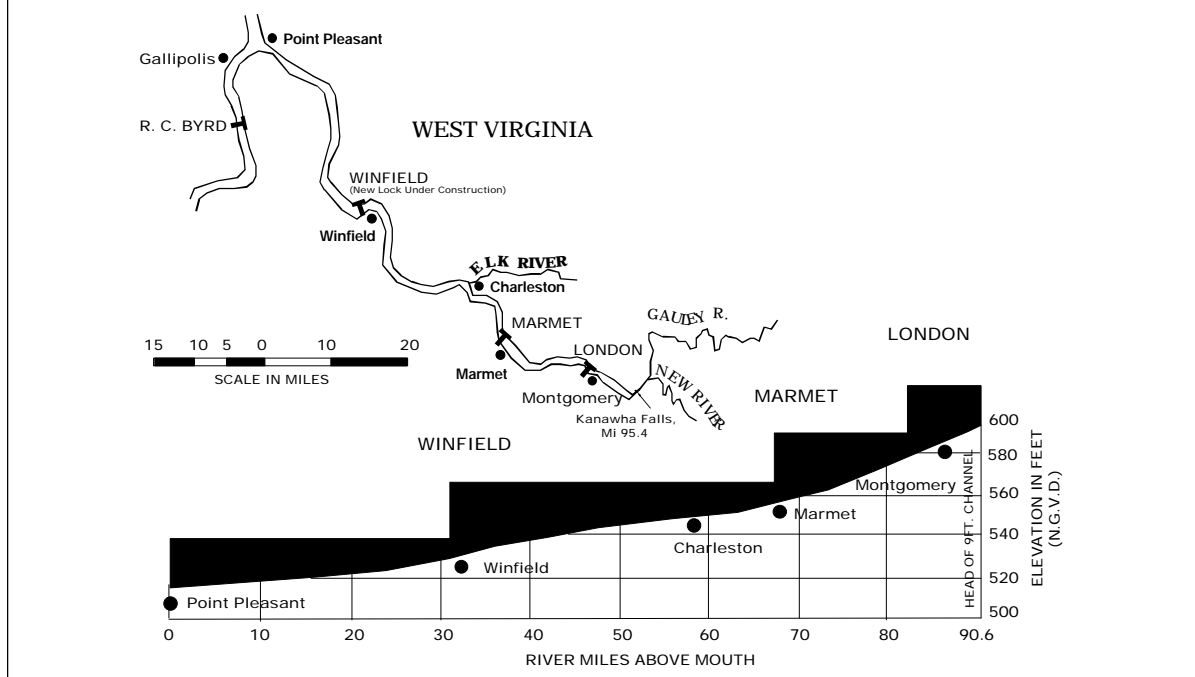
The Kanawha River forms at the junction of the Gauley and New rivers in central West Virginia and flows in a northwesterly direction 95 miles to its mouth at Point Pleasant, West Virginia. Canalization of the Kanawha River began in 1873 to facilitate the movement of coal. By 1898, a 91 mile long, six foot deep, 10 dam system was complete. This system was replaced with the three, high-lift structures between 1931 and 1937. The current Kanawha River plan and profile is presented in Figure 8.

Table 7
Historic Kanawha River Traffic by Commodity
(Million Tons)

Commodity	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	Av. Ann. Rate of Increase 1984-94
Coal & Coke	9.6	10.1	13.6	12.0	13.5	14.6	16.2	17.3	17.1	17.1	17.1	6%
Petroleum	0.9	1.0	1.3	1.0	1.0	1.0	1.2	1.1	1.1	1.1	1.0	1%
Aggregates	1.6	1.6	2.1	2.0	2.1	1.9	2.4	2.1	2.5	3.0	3.1	7%
Chemicals	2.0	1.8	0.9	1.0	0.9	0.9	0.9	0.9	0.9	0.9	0.9	-8%
Ores & Minerals	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.1	0.1	0.0	0.1	0%
Other	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	N/A
Total Traffic	14.2	14.6	18.0	16.2	17.8	18.7	21.0	21.6	21.8	22.3	22.3	5%

Source: WCSC Data

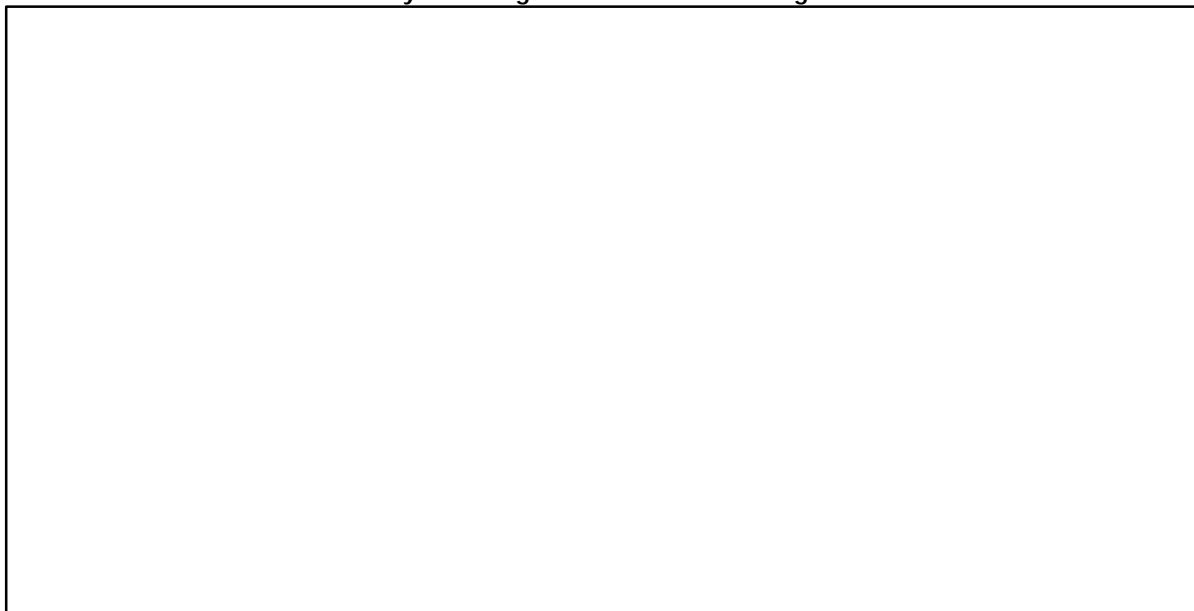
Figure 8
Kanawha River Plan and Profile



Traffic on the Kanawha River has grown dramatically since the present system's completion in 1937. Small lock sizes and rapid growth have caused the Kanawha to become one of the more congested segments of the ORS.

In 1995, Winfield L/D, one of the three locks on the Kanawha River, was the busiest navigation project in the nation, with almost 22,000 lockage cuts and traffic delays averaging 2.8 hours per tow. A new lock now under construction will replace the smaller lock at

Photo 8: Dam Construction at Grays Landing Lock and Dam—Monongahela River



Winfield L/D in the summer of 1998 alleviating the present congestion at Winfield.

Kanawha River traffic, since 1984, has grown at an annual rate of 5 percent. Table 7 shows annual tonnages by commodity group on the Kanawha River from 1984 to 1994. Most of the growth in traffic on the Kanawha River has occurred because of coal and chemical

Monongahela River

The Monongahela River forms at the junction of the Tygart and West Fork rivers in Fairmont, West Virginia and flows north 129 miles to Pittsburgh. The Monongahela Navigation Company began canalization of the river in 1839. By 1844, the company had completed the construction of Locks and Dams 1 through 7. The federal gov-

Table 8
Historic Monongahela River Traffic by Commodity
(Million Tons)

Commodity	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	Av. Ann. Rate of Increase 1984-94
Coal & Coke	30.3	24.8	27.8	28.8	32.8	33.7	32.4	29.4	33.0	28.7	32.4	1%
Petroleum	1.0	0.9	1.1	0.9	0.8	1.1	1.1	0.9	0.8	1.0	1.0	0%
Aggregates	1.7	1.7	2.2	1.9	2.0	1.9	2.3	2.2	2.0	1.8	1.8	1%
Chemicals	0.3	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0%
Ores & Minerals	0.2	0.4	0.2	0.3	0.4	0.4	0.5	0.5	0.6	0.9	0.6	12%
Iron & Steel	0.8	0.5	0.4	0.4	0.4	0.3	0.4	0.4	0.2	0.4	0.5	-5%
Other	0.3	0.3	0.5	0.4	0.6	0.7	0.7	0.7	0.5	0.3	0.3	0%
Total Traffic	34.6	28.8	32.5	33.0	37.3	38.4	37.7	34.4	37.4	33.4	36.9	1%

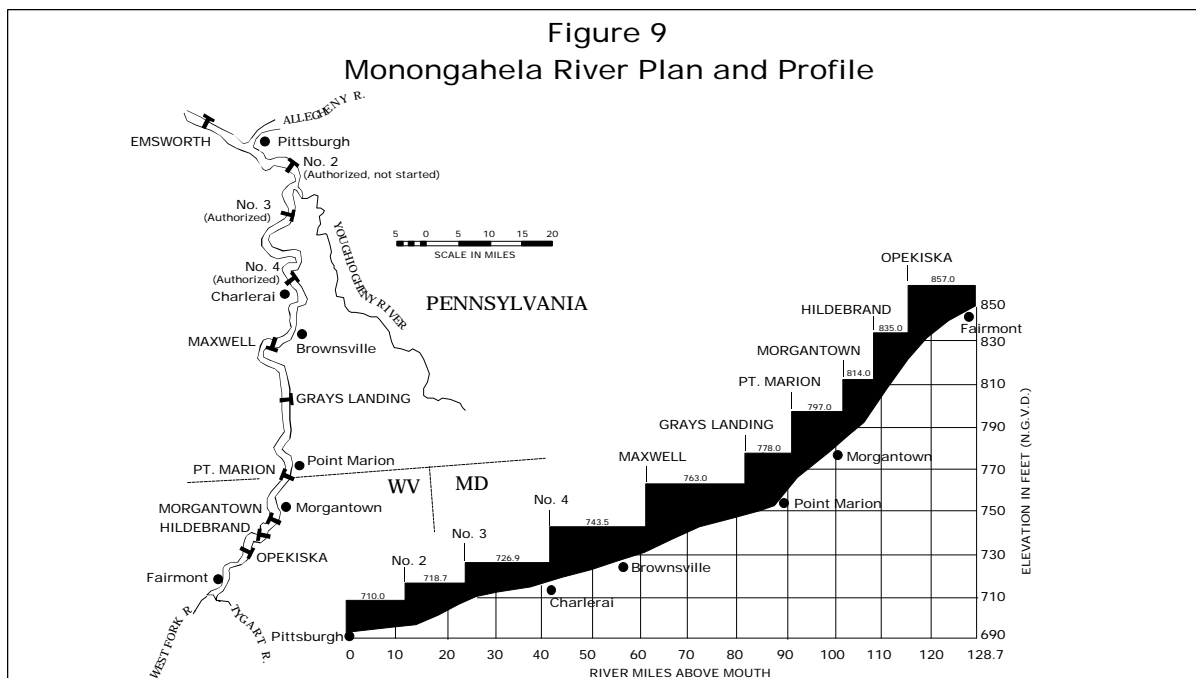
Source: WCSC Data

industry development in the Kanawha River Valley and increased demand for the region's low sulfur coal by coal-fired electric plants. Coal (downbound) is by far the dominant commodity shipped, estimated to be over 70 percent of all traffic at Winfield, and over 90 percent of all traffic at both Marmet and London. Traffic growth is expected to continue, fueled by increased coal shipments. Aggregates, now the second largest commodity on the Kanawha River, grew by about 7 percent within this period. Chemicals traffic has gradually declined as the regional industry has restructured into more specialized, downstream production whose output is less suited to bulk transport.

ernment purchased these structures in 1872 and began construction of Locks and Dams 8 through 15.

In the 1940s, Locks and Dams 2, 4 and 8 were improved with new locks and/or higher lift dams. In addition, new projects were built and L/Ds 1, 5, 6 and 10 through 15 were removed. Figure 9 shows the current plan and profile for the Monongahela River.

This waterway has historically been a major mover of coal from mines in West Virginia and southwestern Pennsylvania to downstream utility and steel plants on the lower Monongahela and Ohio rivers. Between 1984 and 1994 traffic on the Monongahela River increased at an average annual rate



of 1.0 percent. Though coal traffic has grown fairly slowly over the past ten years, it has rebounded dramatically from the early 1980s, when the area's steel industry went through a massive restructuring (see Table 8).

Tennessee River

The Tennessee River system includes the mainstem Tennessee River which extends 652 miles from the junction of the French Broad and Holston rivers at Knoxville, to the mouth at Paducah, Kentucky and about 61 miles of the Clinch River from its junc-

Photo 9: Kentucky Lock and Dam–Tennessee River

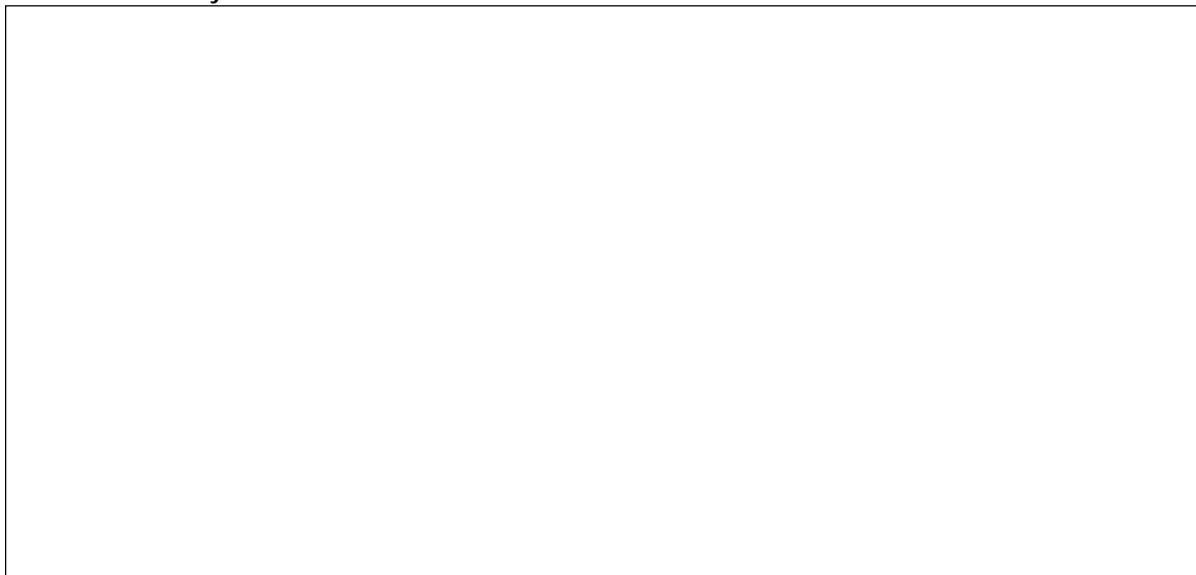


Figure 10
Tennessee River Plan and Profile

tion with the Tennessee River to Clinton, Tennessee. The Tennessee system also includes the Hiwassee and Little Tennessee rivers. The 22 mile long Little Tennessee River is made navigable by Ft. Loudoun L/D, while the 21 mile long Hiwassee River is

made navigable by Chickamauga L/D. A minimum depth of nine feet is maintained on this system. The plan and profile of the river is presented in Figure 10.

Table 9
Historic Tennessee River Traffic by Commodity
(Million Tons)

Commodity	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	Av. Ann. Rate of Increase 1984-94
Coal & Coke	16.3	19.1	21.4	20.3	23.7	20.7	21.9	21.1	21.6	23.3	20.7	2%
Petroleum	1.2	1.1	1.4	1.5	1.6	1.6	1.7	1.5	1.8	1.7	1.7	4%
Aggregates	3.5	3.7	5.4	8.0	8.6	9.6	9.4	6.6	7.3	7.8	9.4	10%
Grain	3.9	3.3	4.0	4.0	4.0	3.5	4.0	3.1	3.6	3.7	4.1	1%
Chemicals	2.4	2.3	2.3	2.2	2.8	2.0	2.1	2.4	2.3	2.6	2.6	1%
Ores & Minerals	1.1	1.2	1.3	1.3	1.2	1.2	1.4	1.2	1.1	1.3	1.4	2%
Iron & Steel	1.3	1.0	1.1	1.1	1.5	1.2	1.2	1.2	1.1	1.2	1.6	2%
Other	3.5	4.7	5.3	3.1	2.8	2.8	2.8	4.9	7.2	6.5	7.2	7%
Total Traffic	33.2	36.4	42.2	41.5	46.2	42.6	44.5	42.0	46.0	48.1	48.7	4%

Source: WCSC Data



Photo 10: Chickamauga Lock and Dam–Tennessee River

The responsibility for development of the Tennessee River basin is shared by the Corps of Engineers and the Tennessee Valley Authority (TVA). The Corps maintains and operates all locks and navigation channels and performs or supervises all necessary dredging and snagging operations, while TVA operates the dams which provide the navigation pool.

There are about 170 terminal facilities on the Tennessee River, of which around 130 are privately owned. Seventy-nine of these terminals have railroad connections. Principal commodity groups are coal and coke, sand and gravel, grain, chemicals and petroleum products.

Table 9 displays annual tonnages on the Tennessee by commodity group between 1984 and 1994. During this period traffic grew at an average annual rate of 4 percent, the third highest growth rate of any ORB river. Every commodity group has experienced growth since 1984. The 48.7 million tons of freight transported in 1994 is the highest of any Ohio River tributary. Growth has been primarily due to increased coal and aggregates traffic. Coal traffic has grown at an annual rate of 2 percent and aggregates

traffic has grown at an average of 10 percent annually between 1984 and 1994. These commodities are expected to drive future growth in Tennessee River traffic.

Cumberland River

The Cumberland River extends 385 miles from Celina, Tennessee, to its mouth near Smithland, Kentucky, and includes the two mile long Barkley Canal. From 1888 to 1924, a system of 14 small locks and dams

Photo 11: Cumberland River Bendway



Figure 11: Cumberland River Plan and Profile

Table 10
Historic Cumberland River Traffic by Commodity
(Million Tons)

Commodity	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	Av. Ann. Rate of Increase 1984-94
Coal & Coke	6.7	5.4	9.5	6.8	6.2	5.2	6.6	6.5	7.6	6.6	5.9	-1%
Petroleum	0.2	0.3	0.3	0.2	0.3	0.3	0.4	0.3	0.4	0.4	0.2	0%
Aggregates	3.0	4.8	5.5	5.8	5.2	5.5	4.6	5.0	4.8	4.5	4.7	5%
Grain	0.2	0.2	1.6	0.2	0.2	0.3	0.2	0.2	0.4	0.4	0.5	10%
Chemicals	0.4	0.3	0.7	0.4	0.4	0.3	0.3	0.4	0.5	0.4	0.5	2%
Ores & Minerals	0.2	0.2	0.4	0.1	0.2	0.1	0.1	0.2	0.2	0.2	0.2	0%
Other	2.8	2.6	3.8	1.2	0.9	1.0	1.0	1.1	1.6	1.0	1.4	-7%
Total Traffic	13.5	13.8	21.8	14.7	13.4	12.7	13.2	13.7	15.5	13.5	13.4	0%

Source: WCSC Data

was constructed that provided a slackwater channel with a minimum depth of six feet.

In 1946, Congress authorized construction of a nine foot channel from its mouth to Nashville, Tennessee. The original plan to replace the existing facilities with three moderately high-lift locks and dams was modified, substituting a large, multi-purpose structure, Barkley Dam and Lake, for the two lower-most locks and dams. The modified plan included a short navigation canal to connect the Cumberland and Tennessee rivers and the provision for future locks at three hydropower projects. The entire navigation improvement program was completed in 1973 with the construction of Cordell Hull L/D.

Figure 11 shows the current plan and profile for the river and the location of the projects involved. At present, no plans to modernize any of the Cumberland projects have been developed.

Although not as heavily used as the Monongahela and Tennessee rivers, the Cumberland River still contributes a substantial amount of traffic to the ORS. Tonnage peaked in 1986 at 21.8 million tons when a major rehabilitation closure of Kentucky Lock

on the Tennessee River forced traffic to re-route through the Barkley Lock on the Cumberland. In general, very little change has occurred in commodity traffic over the 1984 -1994 period (see Table 10). In 1994, commodity traffic stood at 13.4 million tons, which was slightly lower than the 1984 traffic level.

Allegheny River

The Allegheny River extends 72 miles from East Brady, Pennsylvania to Pittsburgh. Federal involvement in navigation began with channel improvements, diversion dams and dikes to facilitate lumber rafting in 1879. L/D 1, completed in 1903, was removed in 1938 when Emsworth pool was raised 7 feet by reconstruction of Emsworth Dam on the Ohio River. L/Ds 2 through 9 were completed from 1920 to 1938. Figure 12 shows the plan and profile for the current Allegheny River navigation system. L/Ds 6 through 9 are closed during the winter, though use is possible by appointment. Presently, no plans to modernize any of the Allegheny projects have been developed.

Overall, Allegheny River traffic has declined since 1984 at an average annual rate of 3

Figure 12
Allegheny River Plan and Profile

percent. The 3.4 million tons of traffic in 1994 represents a 22.7 percent drop from the 1984 level of traffic. The Allegheny River transports relatively small amounts of coal and aggregates. Annual tonnage by commodity group is presented in Table 11. Its heaviest use comes from recreational traffic.

Green River

The Green River flows northwesterly for a distance of 330 miles, from the southern

border of central Kentucky to its mouth on the Ohio River, about eight miles upstream from Evansville, Indiana. A plan and profile of the Green River and its major tributaries, the Barren and Rough rivers, is shown in Figure 13.

A navigation system consisting of four locks and dams on the Green River and one lock and dam on the Barren River was completed by the Commonwealth of Kentucky in 1841. Following acquisition by the federal

Table 11
Historic Allegheny River Traffic by Commodity
(Million Tons)

Commodity	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	Av. Ann. Rate of Increase 1984-94
Coal & Coke	0.9	1.0	1.0	1.0	0.8	0.9	0.9	0.7	1.1	1.1	1.4	5%
Petroleum	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.0	0.0	-100%
Aggregates	2.6	2.0	1.9	2.1	1.7	1.6	1.9	1.5	1.4	1.2	1.4	-6%
Grain	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	N/A
Chemicals	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.1	0.2	0.2	0.2	7%
Ores & Minerals	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0%
Iron & Steel	0.2	0.2	0.2	0.2	0.2	0.1	0.2	0.2	0.2	0.4	0.2	0%
Other	0.4	0.4	0.3	0.1	0.1	0.1	0.1	0.1	0.1	0.3	0.1	-13%
Total Traffic	4.4	3.9	3.8	3.9	3.3	3.2	3.6	2.9	3.3	3.3	3.4	-3%

Source: WCSC Data

government in 1886, the system was expanded by construction of two more locks and dams on the upper Green River and one lock and dam on the Rough River. The completed system provided a 5.5 foot deep navigation channel extending 196 miles on the Green River, 30 miles on the Barren River, and 30 miles on the Rough River.

Owing to a lack of traffic, the Rough River locks and the two uppermost locks on the Green River were closed and deactivated. Increased demands for western Kentucky coal prompted major reconstruction at Green River L/Ds 1 and 2 and an increase

Figure 13
Green River Plan and Profile

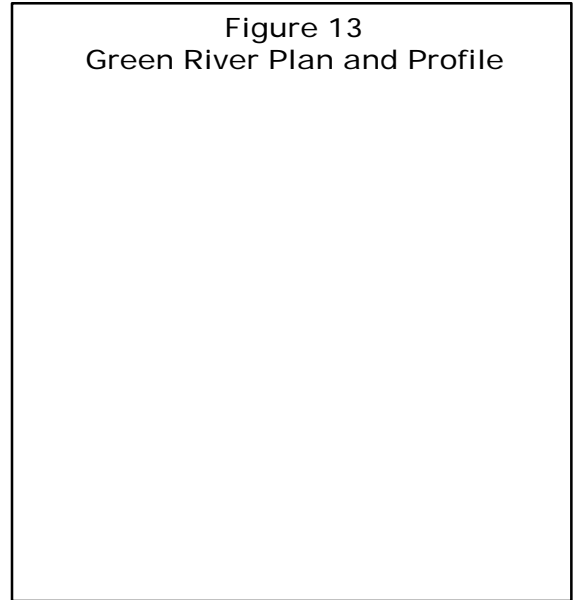


Table 12
Historic Green River Traffic by Commodity
(Million Tons)

Commodity	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	Av. Ann. Rate of Increase 1984-94
Coal & Coke	10.9	10.5	8.8	8.9	7.2	7.5	10.1	9.5	8.6	7.0	7.1	-4%
Aggregates	0.0	0.0	0.1	0.2	0.2	0.1	0.1	0.2	0.1	0.1	0.1	N/A
Grain	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.2	0.2	7%
Ores & Minerals	0.3	0.2	0.2	0.2	0.3	0.4	0.4	0.4	0.4	0.4	0.3	0%
Other	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	7%
Total Traffic	11.4	10.9	9.3	9.5	7.8	8.2	10.8	10.3	9.3	7.8	7.9	-4%

Source: WCSC Data

in channel depth to nine feet in reaches below mile 103 between 1954 and 1956.

Currently, a federally maintained navigation channel is available only as far as mile 103 on the Green River. Between miles 103 and 108.5, the site of L/D 3, a nine foot navigable depth is maintained by private companies. Commercial navigation, above mile 149.5 on the Green River and on the Barren River, ceased in 1965 because of a dam failure at Dam 4. Operation of L/D 3 was terminated and the facility deactivated in 1981. A recently completed feasibility level study found

the extension of navigation on the Green and Barren Rivers to be economically infeasible at this time.

Commodity traffic on the Green and Barren Rivers amounted to about 8 million tons, which represented an annual decline of about 4 percent from the 1984 traffic level. Coal and grains mostly move outbound, and aggregates and ores mostly move inbound on the Green. Green River utility plants receive limestone for use in their scrubbers. Coal accounts for most of the traffic but has declined 4 percent since 1984, reflecting

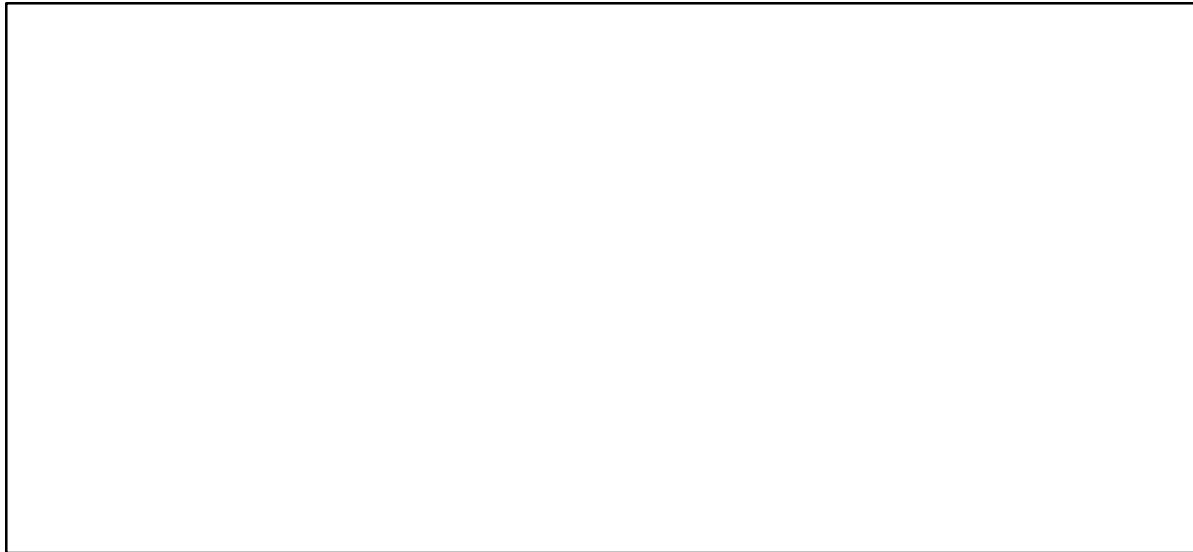


Photo 12: Confluence of Big Sandy and Ohio Rivers

lower demand from ORS power plants for this region's high sulfur coal (see Table 12).

Big Sandy River

The Big Sandy River empties into the Greenup pool near Kenova, West Virginia at Ohio River mile 317. Federal involvement in navigation on the Big Sandy was authorized by the River and Harbor Acts of 1880 and 1889, and construction lasted from 1897 to 1910. The system included three locks on the Big Sandy mainstem and one lock each on the Levisa and Tug forks.

Although original plans called for the construction of nine additional locks on the Levisa Fork and seven additional locks on the Tug Fork, the completion of rail lines in the region diminished the need for navigation to such an extent that the original plans were abandoned. At the present time, a navigable depth of nine feet is available for only about 8.7 miles due to a severe sedimentation problem. Frequent maintenance dredging is performed by the Corps of Engineers to permit passage of commercial traffic in the lower reaches.

Table 13
Historic Big Sandy River Traffic by Commodity
(Million Tons)

Commodity	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	Av. Ann. Rate of Increase 1984-94
Coal & Coke	5.7	6.7	7.9	9.1	11.6	14.3	19.0	19.6	20.0	21.0	19.4	13%
Petroleum	2.4	2.4	2.2	2.0	2.0	1.8	1.9	2.3	2.2	0.6	0.5	-15%
Aggregates	0.2	0.2	0.1	0.1	0.1	0.0	0.2	0.1	0.0	0.0	0.0	-100%
Chemicals	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.1	0.0	0.4	0.5	17%
Iron & Steel	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	N/A
Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	1.5	N/A
Total Traffic	8.4	9.4	10.4	11.4	13.9	16.2	21.2	22.2	22.3	23.4	22.1	10%

Source: WCSC Data

Navigation on the Big Sandy River has increased due to growth in demand for the region's bituminous coal and the already high density of river terminals on the Ohio River in the Port of Huntington. In fact, in terms of total traffic, the Big Sandy River has demonstrated the most robust growth of all the navigable ORB rivers. Between 1984 and 1994, coal shipments on the Big Sandy increased at an average annual rate of 13 percent. Table 13 presents annual Big Sandy commerce by commodity group.

Barkley Canal

The Barkley Canal connects the Cumberland River above Barkley L/D with the Tennessee River above Kentucky L/D. It is a 1.5 mile long channel between Lake Barkley and Kentucky Lake and was constructed in 1966 to optimize hydropower operations at Barkley and Kentucky dams by transferring water between the Cumberland and Tennessee rivers.

The canal also serves as a navigation intersection, allowing a diversion of traffic from the narrow, circuitous lower Cumberland River. Diversion of lower Cumberland traffic through the canal is evidenced by the fact that traffic at Barkley Canal grew at an average annual rate of increase of 8 percent per year during the period of 1984 - 1994. Over 8.7 million tons of traffic passed through the Barkley Canal in 1994. The traffic was mostly coal, accounting for over 50 percent of the Canal's total traffic. Table 14 presents historic Barkley Canal traffic by commodity group.

Kentucky River

The Kentucky River extends about 255 miles from its formation near Beattyville, Kentucky, but only the lower 82 miles are operated and maintained for commercial navigation. Construction of the Kentucky River project was authorized by the Commonwealth in 1835 and five lock and dam structures were built. It was never profitable and was closed in 1873. The

Table 14
Historic Barkley Canal Traffic by Commodity
(Million Tons)

Commodity	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	Av. Ann. Rate of Increase
Coal & Coke	2.0	3.9	6.5	4.8	5.5	4.8	6.6	5.7	6.2	5.5	4.9	9%
Petroleum	0.2	0.3	0.3	0.3	0.3	0.3	0.4	0.3	0.2	0.1	0.0	N/A
Aggregates	0.1	0.4	1.5	0.4	0.3	0.3	0.3	0.8	1.1	0.7	1.6	32%
Grain	0.2	0.2	1.5	0.1	0.1	0.1	0.2	0.1	0.2	0.2	0.3	4%
Chemicals	0.4	0.3	0.6	0.4	0.4	0.3	0.2	0.3	0.3	0.3	0.4	0%
Ores & Minerals	0.1	0.1	0.3	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0%
Iron & Steel	0.5	0.4	0.5	0.4	0.5	0.4	0.6	0.6	0.6	0.5	0.6	2%
Other	0.6	0.8	1.4	1.0	0.8	0.9	0.9	0.9	1.1	0.6	0.8	3%
Total Traffic	4.1	6.4	12.6	7.5	8.0	7.2	9.3	8.8	9.8	8.0	8.7	8%

Source: WCSC Data

five structures were conveyed to the Federal Government and reopened in 1880. The federal government completed a 14 project system between 1865 and 1917, providing a six foot navigable channel for the river. Lock chambers were typically 145' by 38'. The system remained in service until 1975 when the upper 10 locks were closed due to insufficient traffic. These 10 locks were later reopened and since 1991 have been in the control of the state of Kentucky. The commonwealth operates these locks principally for weekend recreational boaters.

The present commercial Kentucky River navigation system consists of four structures, L/Ds 1 through 4. They provide six foot deep navigation pools for the lower 82 miles of the river. Commercial traffic volumes are relatively small, amounting to only about 0.3 million tons in 1994. Between 1984 and 1994 traffic on the Kentucky River never exceeded the 0.2 - 0.3 million ton range. Traffic is mainly inbound and consists of sand, gravel, and crushed rock.

PART 3

Waterway Improvements

State of the Ohio River System

The efficiency of the Ohio River navigation system depends upon a reliable infrastructure. The federal government provides a system of 60 locks and dams and over 2,800 miles of marked navigable channel. Shippers and terminal operators manage the loading docks and terminals on the basin's rivers, and waterway carriers operate towboats, barges and maintenance facilities. Government expenditures go primarily to operate and maintain the locks and dams. Table 15 lists specifications with respect to age and size for the Ohio River System navigation projects.

On the Ohio River, seventeen of the twenty projects have main chambers 1200' by 110'. These locks range from 3 to 38 years old. The three smaller 600' by 110' main chamber sites on the upper Ohio have been rehabilitated recently. At Robert C. Byrd Locks (formerly Gallipolis Locks), a new 1200' by 110' main chamber and 600' by 110' auxiliary chamber were opened in early 1993.

On the Tennessee River, the first six main chamber locks are 600' by 110', except for Pickwick which is 1000' by 110'. These facilities range from 13 to 56 years in age. The Cumberland River has two 800' by 110' single chamber locks on the lower river that average 36 years and two single 400' by 84' chamber locks on the upper river that average 31 years. The Kanawha River's three locks and dams have twin chambers that measure 360' by 56' and are 60-63 years old. On the Monongahela River, the four downriver locks and dams have dual chambers and average 56 years. The five upriver projects have one chamber and average 51 years in age.

Many of the locks no longer satisfy today's operating standards or tow sizes. In general, this equates to locks which are too small, slow to fill and empty, costly to operate, and expensive to maintain. Also, older locks are closed for major maintenance more frequently than are modern locks.

Lock capacities correlate with lock sizes, and many of the smaller locks have become congested due to increased traffic. The congestion produces delays, adds to industry's costs, and reduces transportation savings. In terms of lockage cuts, Winfield L/D on the Kanawha River is the busiest in the system. Due to its small size and incompatibility with modern tows, 21,824 lockage cuts were required to process Winfield's 1995 traffic level of 22.0 million tons, resulting in an average chambering time of 2.8 hours and average delay per tow of 2.8 hours.

By contrast, Smithland L/D on the lower Ohio River with its twin 1200' long chambers processed 89.1 million tons in 9,036 lockage cuts, with an average delay of 0.3 hours and an average chambering time of only 0.7 hours.

The Corps' waterway management program for the ORS is designed to assure the basin's waterways will be capable of meeting both current and future traffic demands in a safe, reliable and efficient manner. This requires an effective maintenance and modernization program. Effective maintenance requires periodic removal of sediment load, which is continuously deposited by natural processes. Unattended sediment and silt along with high and low water flows build shoals and bars which reduce channel depth. Carefully managed dredging is essential to the maintenance of adequate navigation depths. This work is primarily accomplished by private contractors under the direction of the Corps.

The upkeep of ORS navigation structures involves maintenance, rehabilitation and replacement. Maintenance includes periodic minor repairs as well as emergency repairs and is funded through the normal operations and maintenance budget. Rehabilitation involves improving the reliability or operational efficiency of an existing structure and is funded under the construction budget. Replacement involves congressional approval and authorization for construction.

The Modernization Process

The modernization process involves four steps. First, a reconnaissance study identifies issues, concerns, and opportunities in order to determine the federal interest in constructing navigation improvements. If a federal interest is identified, the District Engineer will recommend that a feasibility study be initiated. This second step allows the Corps to more fully examine

nonstructural and structural alternatives and to identify a preferred alternative.

Feasibility is established when an improvement plan is found that provides more transportation savings than the improvements will cost, appropriately addresses environmental concerns and is acceptable to users. The feasibility study is necessary but is not sufficient alone for a congressional authorization of the improvement alternative. From feasibility, the process moves into the preconstruction engineering and design phase. Following authorization, funding is appropriated for construction. During this final step of the modernization process, plans and specifications for construction are prepared. A project is said to be programmed for modernization if it falls into any one of these steps, including the transitory phase of awaiting authorization or appropriation.

The modernization of the ORS represents investment that will be repaid many times over in future years. Modernization eradicates hazardous conditions and eliminates costly delays. Freight savings are just the beginning, as the economic effects of federal construction will diffuse to a wide variety of producers of equipment, materials, energy forms, technical services and skills. Areas of high unemployment find relief through increased job openings and income flowing into communities. The multiplier effect of this spending translates into increased incomes which generate local responding, creating additional income for retail stores, professional services and public agencies. Other spin-offs of ORS improvement projects include greater supplies of hydroelectric power, increased municipal water sources, improvements to roads, bridges and other facilities, and the opening up of area land development. Investments in waterway projects amount to good public policy.

Table 15
Lock and Dam Specifications

River/ Project	@ Mile	Operational			Rehabilitated			Lock Size	
		Main	Aux.	Dam	Main	Aux.	Dam	Main	Aux.
Ohio River									
Emsworth	6.2	1921	1921	1922	1984	1984	1984	600x110	360x56
Dashields	13.3	1929	1929	1929	1990	1990	1990	600x110	360x56
Montgomery	31.7	1936	1936	1936	1989	1989	1989	600x110	360x56
N. Cumberland	54.4	1956	1959	1961				1200x110	600x110
Pike Island	84.2	1963	1963	1965				1200x110	600x110
Hannibal	126.4	1972	1972	1975				1200x110	600x110
Willow Island	162.4	1972	1972	1973				1200x110	600x110
Belleville	203.9	1968	1968	1969				1200x110	600x110
Racine	237.5	1967	1967	1970				1200x110	600x110
R.C . Byrd	279.2	1993	1993	1937			1937	1200x110	600x110
Greenup	341.0	1959	1959	1962				1200x110	600x110
Meldahl	436.2	1962	1962	1964				1200x110	600x110
Markland	531.5	1959	1959	1964				1200x110	600x110
McAlpine	606.8	1961	1921	1964		1965		1200x110	600x110
Cannelton	720.7	1971	1971	1971				1200x110	600x110
Newburgh	776.1	1975	1975	1975				1200x110	600x110
Uniontown	846.0	1975	1975	1975				1200x110	600x110
Smithland	918.5	1979	1979	1979				1200x110	600x110
L&D No. 52	938.9	1969	1928	1929	1983	1983	1984	1200x110	600x110
L&D No. 53	962.6	1980	1929	1929	1983	1982	1984	1200x110	600x110
Kanawha River									
London	82.8	1933	1933	1934				360x56	360x56
Marmet	67.8	1934	1934	1934				360x56	360x56
Winfield	31.1	1935	1935	1937				360x56	360x56
Monogahela River									
Opekiska	115.4	1964		1967				600x84	
Hildebrand	108.0	1959		1960				600x84	
Morgantown	102.0	1950		1950				600x84	
Point Marion	90.8	1993		1994				720x84	
L/D 7 *	85.0	1925		1926				360x56	
Grays Landing	82.0	1993		1995				720x84	
Maxwell	61.2	1964	1964	1965				720x84	720x84
No. 4	41.5	1932	1932	1933	1964	1964	1967	720x56	360x56
No. 3	23.8	1906	1906	1907	1981	1981	1979	720x56	360x56
No. 2	11.2	1905	1905	1906	1953	1953		720x110	360x56

*L/D 7 ceased operations July 30, 1995

Table 15 continued
Lock and Dam Specifications

River/ Project		Operational			Rehabilitated			Lock Size	
	@ Mile	Main	Aux.	Dam	Main	Aux.	Dam	Main	Aux.
Allegheny River									
No. 9	62.2	1938		1938				360x56	
No. 8	52.6	1931		1931		1937		360x56	
No. 7	45.7	1930		1931				360x56	
No. 6	36.3	1928		1928				360x56	
No. 5	30.4	1927		1927				360x56	
No. 4	24.2	1934		1934				360x56	
No. 3	14.5	1934		1934				360x56	
No. 2	6.7	1934		1934				360x56	
Green River									
No. 2	63.1	1956		1957				600x84	
No. 1	6.7	1956		1957			1970	600x84	
Cumberland River									
Cordell Hull	313.5	1973		1974				400x84	
Old Hickory	216.2	1954		1957				400x84	
Cheatham	148.7	1952		1954				800x110	
Barkley	30.6	1964		1966				800x110	
Tennessee River									
Fort Loudoun	602.3	1943		1943				360x60	
Watts Bar	529.3	1941		1944				360x60	
Chickamauga	471.0	1939		1940				360x60	
Nickajack	424.7	1967		1968				600x110	
Gunthersville	349.0	1965	1937	1939				600x110	360x60
Gen. Wheeler	274.9	1963	1934	1937		1962		600x110	400x60
Wilson*	259.4		1927			1961			300x60
Wilson**	259.4	1959	1927	1925		1967		600x110	292x60
Pickwick	206.7	1984	1937	1938				1000x110	600x110
Kentucky	22.4	1942		1944				600x110	
Clinch River									
Melton Hill	23.1	1963		1963				400x75	
Kentucky River									
No. 5-14**									
No. 4	65.0	1844		1844				145x38	
No. 3	42.0	1844		1844				145x38	
No. 2	31.0	1839		1839				145x38	
No. 1	4.0	1839		1839				145x38	

* Two auxiliary locks in series to form a single, dual lift lock.

** Federal Govt. no longer operates.

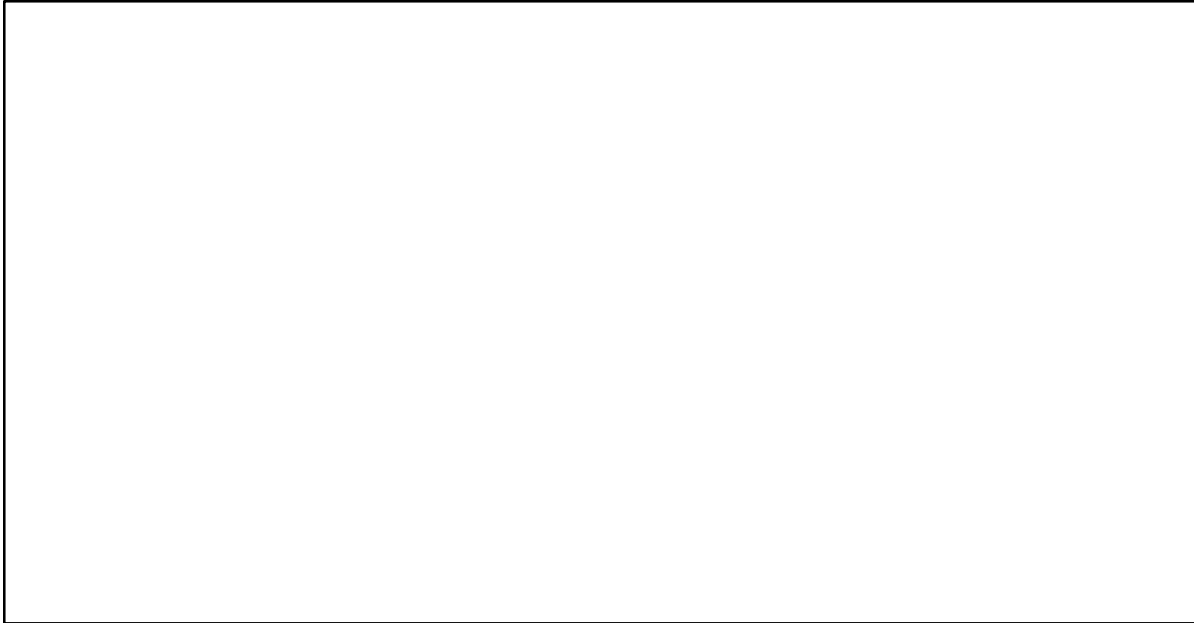


Photo 13: Winfield Locks Under Construction

Authorized ORB Projects

The Water Resources Development Act of 1986 authorized improvements at four ORS navigation projects: Gallipolis on the Ohio River, Grays Landing and Point Marion on the Monongahela River, and Winfield on the Kanawha River. In November 1987, the Corps of Engineers began construction of a 1200' by 110' main lock and a 600' by 110' auxiliary lock in a by-pass canal at Gallipolis, Ohio River mile 279.0. In January 1993, the first tow passed through the new Robert C. Byrd Locks, with dam rehabilitation scheduled for completion by August 1998. The replacement of Monongahela River L/D 7 with Grays Landing at river mile 82.2 began in June 1988. The new 720' by 84' lock has been operational since February 1993. Construction began in May 1990 on the new 720' by 84' lock at Point Marion, river mile 90.8. This new lock structure was opened to navigation in December 1993. In May 1990, ground was broken at Winfield, Kanawha River mile 31.1. The improvement plan at Winfield involves rehabilita-

tion of the existing 360' by 56' locks and construction of a new landward 800' by 110' lock, which is scheduled for completion by March of 1998.

The Water Resources Development Act of 1988 authorized the Olmsted L/D project. This new facility at Ohio River mile 964.4 will consist of twin 1200' by 110' lock chambers and a dam with submersible gates, allowing tow passage during higher flow conditions. It will replace Ohio River L/Ds 52 and 53. Construction began in early 1993 and, based on the current schedule for completion, the new facility will be operational by the year 2008.

The Water Resources Development Act of 1990 authorized the improvement of McAlpine L/D at Ohio River mile 606.8 in Louisville Harbor. The improved McAlpine L/D, scheduled for completion in 2006, will consist of twin 1200' by 110' locks.

The Water Resources Development Act of 1992 authorized improvements of the Monongahela River Locks and Dams 2, 3

and 4. Authorized improvements to the lower Monongahela River include a new gated dam and rehabilitation of the locks at L/D 2, the removal of L/D 3, and new twin 720' by 84' locks at L/D 4. The Lower Monongahela project is currently in the preconstruction engineering and design phase, with construction scheduled for completion in 2004.

In 1996 Congress authorized the modernization of Kentucky Lock on the Tennessee River and Marmet Locks on the Kanawha River. The Corps recommended construction of a new 1200' by 110' lock landward of the existing 600' by 110' Kentucky Lock and a new 800' by 110' lock landward of the existing Marmet Locks.

Ongoing ORB Studies

Studies are underway at problem areas in the ORB. The problems at these sites are generally related to traffic congestion and

structure condition. Current modernization studies are listed as follows:

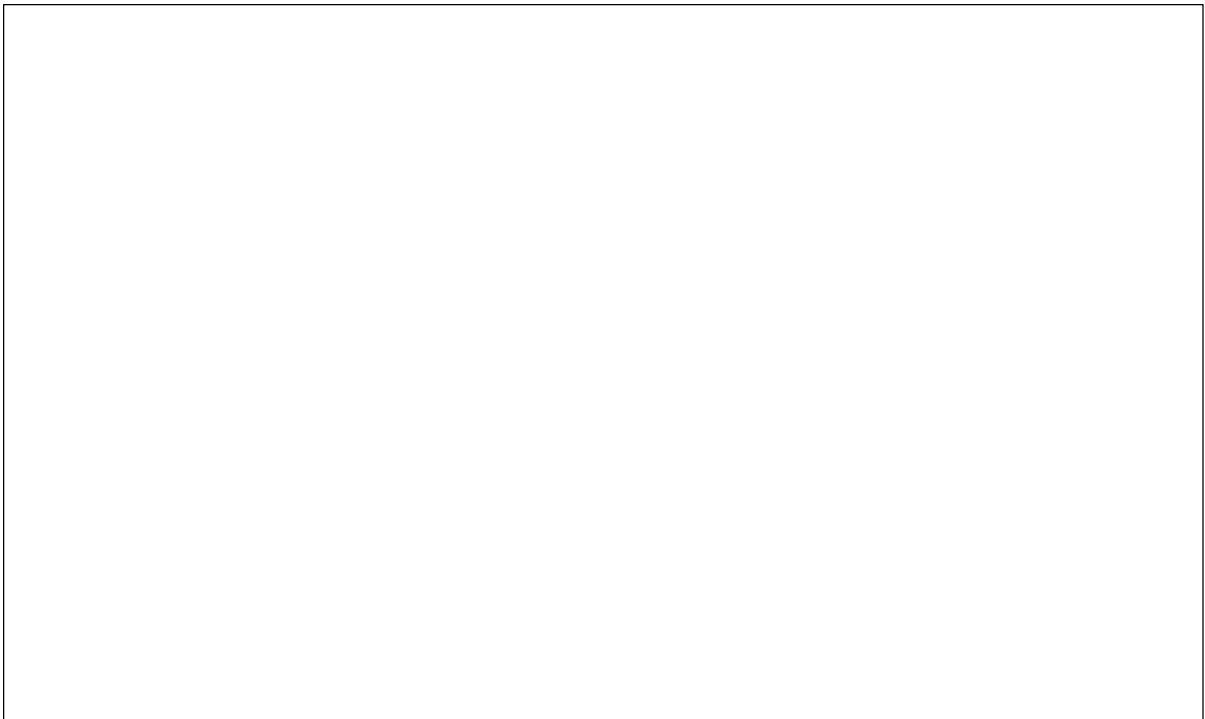
Ohio River Main Stem Study

This study began in 1990, initially focusing on the feasibility of improving navigation along the lower Ohio River. As the study progressed, the focus area broadened to encompass the entire main stem Ohio River. The objective is to evaluate the economic, engineering, and environmental aspects of the present and future Ohio River navigation system and develop alternative plans to address any navigational needs identified. For this effort, new risk-based analysis techniques are being developed for estimating the economic benefits of navigation improvements and evaluating low capital cost lock construction alternatives.

Kanawha River Navigation Study

The last of three interim reports on the Kanawha River is currently underway. London Locks and Dam is the uppermost navigation project,

Photo 14: Olmsted Locks and Dam Under Construction



located at Kanawha River Mile 82.8 and includes twin 360' by 56' chambers. The small size of the lock chambers impedes traffic, resulting in long processing times and increased delay. The feasibility study will examine alternatives to increase lockage efficiency at London Locks.

Industry Partners

The waterway industry plays an essential role in improving the reliability and capacity of the waterways. The industry contributes half the cost of the replacement of federally owned and operated navigation projects on fuel-taxed waterways. Since 1980, when fuel taxes were first imposed, waterway users have been contributing to the Inland Waterways Trust Fund. This tax began at \$0.04 per gallon in October 1980 and gradually increased to its current level of \$0.20 per gallon in 1995. The fund will be used to provide the industry's share of the cost of lock and dam modernization. These costs are in addition to the cost of maintaining their own equipment and loading facilities.

The industry also has been a valuable participant in modernization planning as it helps the Corps establish priorities, choose among plan alternatives and establish navigability of improvement plans. This function was formalized when Congress established the Inland Waterway Users Board in 1986. The primary purpose of this 11-member board of waterway users and shippers is to represent the various segments of the waterway and to recommend the prioritization of projects to the Assistant Secretary of the Army and Congress. The Board also advocates cost effective rehabilitation and construction. In response to this concern, the Corps has instituted a cost-reduction program. Cost-reduction initiatives focus on incorporating innovative design

and construction techniques into program formulation in order to reduce project costs. Further partnering and communication between the Corps and industry with respect to design and construction technology is critical to the success of these initiatives.

The Association for the Development of Inland Navigation in America's Ohio Valley, DINAMO, has been very effective in promoting navigation improvements. Other important groups in the ORB working toward a better navigation system are: the Big Sandy Improvement Committee, the Waterways Association of Pittsburgh, the Huntington District Waterway Advisory Committee, the Tennessee River Valley Association and its partner the Tennessee-Cumberland Waterways Council, the Ohio River Ice Committee and the Waterway Industry Executive Task Group.

PART 4

Regional Commerce

Waterway Impact on Regional Economy

For industries requiring or producing large volumes of solid and liquid bulk commodities, the availability of waterway transportation is a primary consideration in choosing location. There are over 50 coal-powered electric power plants located along the waterways of the ORS. The Corps reports that about 80 percent of all the coal moved on the ORS is consigned to electric power plants. The preference for riverside plant location is due to the ready availability of large quantities of cooling water and lower cost water transportation. These power plants generate about 10 percent of the nation's total electric power needs. The transportation costs for these power plants are estimated to be about 33

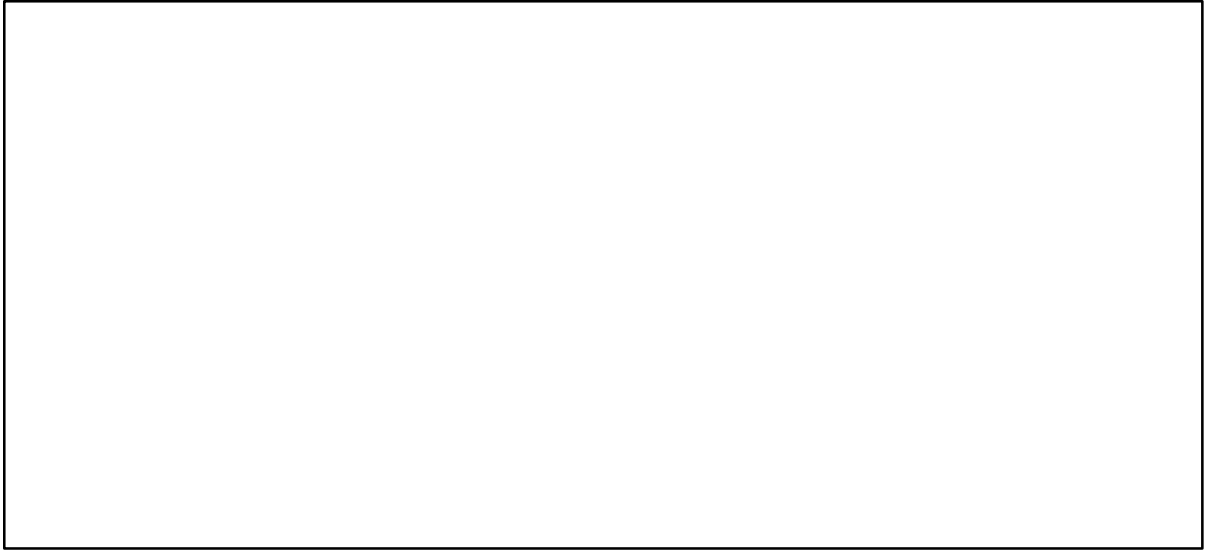


Photo 15: Waterside Electric Utility

percent as much as the least costly alternative mode of transportation. This saving is passed on as lower electricity costs to consumers and thus a significant percentage of the nation's electricity users benefit directly from the availability of inexpensive waterway transportation.

The inland waterway system facilitates economic development by offering:

- lower transportation costs for bulk commodities;
- wider contact between internal and external markets;
- lower energy costs for commercial and industrial activities;
- better access to and lower cost for raw material inputs to production;
- more reliable water supplies for recreational and industrial water use;
- spin-off commercial and support activities;
- and finally, more opportunities for the creation and provision of jobs.

1994 Ohio River Basin Commerce

The fertile land and rich mineral resources of the Ohio River basin form the foundation of this region's interdependent, regional agro-industrial economy. A well-developed system of highways, railways, and waterways serve to link production areas (quarries, mines, and refineries) with consumption points (power plants, steel mills, aluminium smelters and chemical plants) located within and outside the basin. While coal and coke products are the most important commodities hauled on the basin's rivers, measured in terms of their impact on the region's economy, recent growth in ORS waterborne commerce has been driven largely by increased ores, iron and steel, and aggregates traffic. Total ORS traffic increased 3.4 percent between 1992 and 1994, while coal traffic remained essentially flat. During this same period, aggregates, ores, and iron and steel traffic as a group increased 22 percent, while grains, petroleum and petroleum products, and chemicals traffic increased by about 6 percent. Table 16 shows the distribution of ORS shipments and receipts in the basin. Total shipments equal total receipts because no commerce was lost in the system.

Table 16
1994 Basin-Wide Waterborne Commerce
(Million Tons)

Commodity	ORB	SHIPMENTS	Total
		Outside	
Coal & Coke	157.3	1.3	158.6
Petroleum Fuels	10.7	3.5	14.2
Aggregate	36.3	0.1	36.4
Grain	11.0	1.2	12.2
Chemicals	2.8	7.9	10.7
Ores & Minerals	0.5	6.1	6.6
Iron & Steel	3.4	6.3	9.7
Other	14.7	3.9	18.6
Total	236.7	30.3	267.0

Commodity	ORB	RECEIPTS	Total
		Outside	
Coal & Coke	136.2	22.4	158.6
Petroleum Fuels	13.5	0.7	14.2
Aggregate	31.0	5.4	36.4
Grain	4.3	7.9	12.2
Chemicals	9.8	0.9	10.7
Ores & Minerals	6.5	0.1	6.6
Iron & Steel	7.8	1.9	9.7
Other	11.6	7.0	18.6
Total	220.8	46.2	267.0

Source:WCSC Data

Of the 267 million tons of commerce moved in the basin, 89 percent was shipped from ORB states and 11 percent was shipped from states outside the basin. There were 236.7 million tons of ORB shipments and 220.8 million tons were received by the eight basin states. Major outside states that export to the ORB are Louisiana (21 million tons) and Texas (5 million tons).

A Bureau of Economic Analysis (BEA) economic area consists of a standard metropolitan statistical area (SMSA), serving as a center of economic activity, and its surrounding counties. Figure 14 shows the 53 BEA economic areas that either shipped or received ORB commerce in 1994. Only 36 percent of the BEA economic areas are within the ORB. This indicates that the movement of ORB commerce is not restricted to the ORB. Tables 17 & 18 show the distribution by commodity group of 1994 ORB commerce to BEA economic areas.

Three BEAs accounted for over 46 percent of all ORB shipments. The largest shipping BEAs were Huntington, Evansville and Paducah with 50.4, 38.2 and 35.3 million tons, respectively. Coal comprised 71 percent of this tonnage; 15 percent was aggregates; 7 percent was petroleum products; and 4 percent was grains.

In 1994 the primary recipient BEAs of 1994 ORB traffic were Pittsburgh, Cincinnati, Evansville and New Orleans with 40.3, 35.4, 27.3, and 26.8 million tons, respectively. Over 66 percent of this tonnage consisted of coal. These four BEAs accounted for over 48 percent of ORB commerce received. Coal and grains destined for export comprised 87 percent of the ORB traffic received in New Orleans, LA.

Most of the ORS traffic comes from the extensive industrial and commercial riverside development in the basin. This is due to the availability of easily developable land with direct access to the river, and the economic advantage of waterway transportation for bulk commodities. It is anticipated that riverside industrial development and the related growth in navigation traffic will continue into the future.

PART 5

1995 Project Statistics

Commercial Tonnage

Commercial tonnage, by project and commodity group, is displayed in Table 19. Coal is the dominant commodity moved through locks on the Ohio, Green, Kanawha, Monongahela, and Ohio rivers, while aggregates and/or grains are the dominant commodity at most locks on the Allegheny, Cumberland, and Tennessee rivers. Traffic tends to be heaviest at projects on the lower reaches of the Ohio River and its

Figure 14
BEA Economic Areas Shipping or Receiving ORB Commerce

Photo 16: Kanawha River Chemical Industry

Table 17
1994 Shipments by Bureau of Economic Analysis (BEA) Areas*
(Kilotons)

BEA	BEA NAME	Coal & Coke	Petro - leum	Aggre- gates	Grain	Chemicals	Ores & Minerals	Iron & Steel	Other	Total
16	Pittsburgh,PA	16,124	283	2,616	3	213	44	530	166	19,977
40	Albany,GA	0	0	0	0	0	0	0	1	1
46	Pensacola,FL	0	0	0	0	0	0	0	15	15
47	Mobile,AL	5	56	4	1	102	4	10	428	611
49	Birmingham,AL	27	0	61	0	0	0	20	335	443
50	Huntsville,AL	51	106	308	191	303	1	114	767	1,841
51	Chattanooga,TN	450	13	724	2	124	0	99	154	1,566
53	Knoxville,TN	0	0	10	244	18	155	52	7	486
54	Nashville,TN	2	0	945	500	33	0	256	56	1,791
55	Memphis,TN	6	542	719	10	101	0	266	441	2,084
56	Paducah,KY	20,801	90	15,487	511	161	32	110	1,057	38,249
57	Louisville,KY	728	20	9,035	891	59	48	176	681	11,637
59	Huntington,WV	41,662	6,557	155	44	679	2	44	1,269	50,410
60	Charleston,WV	17,028	7	5	2	91	0	13	8	17,155
61	Morgantown,WV	8,678	0	643	0	0	0	0	0	9,321
62	Parkersburg,WV	52	252	9	0	30	61	20	59	483
63	Wheeling,WV	16,136	361	1,233	0	216	1	844	119	18,910
64	Youngstown,OH	5	149	12	2	2	1	51	47	270
66	Columbus,OH	2,581	0	1,178	0	191	46	0	2	3,997
67	Cincinnati,OH	5,529	105	3,719	2,664	74	4	550	1,266	13,911
80	Evansville,IN	25,212	2,253	2,428	4,265	165	8	239	761	35,331
83	Chicago,IL	632	195	15	1,054	62	5	177	220	2,360
85	Springfield,IL	0	0	0	110	3	0	0	0	114
86	Quincy,IL	0	0	0	157	65	18	0	118	358
87	Peoria,IL	1	0	0	238	89	0	24	1	354
89	Milwaukee,WI	0	0	0	0	0	0	5	0	5
91	La Crosse,WI	0	0	0	2	0	0	0	0	2
96	Minneapolis,MN	89	37	0	276	187	3	12	11	615
98	Dubuque,IA	0	0	0	109	2	0	0	0	111
99	Davenport,IA	0	0	0	419	0	16	24	0	459
105	Kansas City,MO	0	0	0	32	0	0	0	0	32
107	St Louis,MO	1,641	214	63	2,534	258	48	254	1,755	6,766
111	Little Rock,AR	0	7	6	5	49	12	15	8	102
112	Jackson,MS	0	29	0	0	138	0	0	248	415
113	New Orleans,LA	415	1,548	14	183	1,385	866	2,741	1,346	8,499
114	Baton Rouge,LA	541	1,167	58	66	2,597	1,315	2,855	439	9,039
115	Lafayette,LA	0	233	0	5	16	2,916	2	7	3,180
116	Lake Charles,LA	53	98	0	17	229	0	0	2	399
117	Shreveport,LA	0	0	0	0	0	0	0	21	21
118	Monroe,LA	0	0	0	2	5	0	0	1	9
121	Beaumont,TX	156	66	0	0	340	0	116	5	683
122	Houston,TX	12	402	3	0	2,086	787	29	120	3,439
130	Corpus Christi,TX	0	20	0	0	465	145	0	178	808
131	Brownsville,TX	0	0	0	0	0	21	6	8	35
138	Tulsa,OK	24	19	0	379	178	3	0	17	621
142	Lincoln,NE	0	0	0	14	0	0	0	0	14
143	Omaha,NE	0	0	0	58	0	0	0	0	58
Total		158,641	14,828	39,448	14,992	10,717	6,562	9,651	12,145	266,984

* A Bureau of Economic Analysis (BEA) economic area consists of a standard metropolitan statistical area (SMSA) serving as a center of economic activity and its surrounding counties.

Source: WCSC Data.

Table 18
1994 Receipts by Bureau of Economic Analysis (BEA) Areas*
(Kilotons)

BEA	BEA NAME	Coal & Coke	Petro- leum	Aggre- gates	Grain	Chemicals	Ores & Minerals	Iron & Steel	Other	Total
16	Pittsburgh,PA	29,722	1,828	4,777	65	852	841	912	1,336	40,334
23	Norfolk,VA	0	0	0	0	0	0	0	1	1
46	Pensacola,FL	3,615	0	385	30	76	0	0	7	4,113
47	Mobile,AL	1,326	0	594	10	0	0	5	103	2,038
48	Montgomery,AL	0	0	2	0	0	0	0	0	2
49	Birmingham,AL	1,130	0	75	0	3	2	3	331	1,544
50	Huntsville,AL	6,034	229	236	2,811	846	58	207	493	10,914
51	Chattanooga,TN	1,975	185	1,089	376	137	409	178	800	5,149
53	Knoxville,TN	8	0	51	506	59	229	16	208	1,076
54	Nashville,TN	9,249	244	3,367	0	592	417	663	1,199	15,731
55	Memphis,TN	3,690	64	4,247	75	129	2	1,069	570	9,845
56	Paducah,KY	3,578	1,107	377	0	691	293	148	385	6,579
57	Louisville,KY	7,366	3,369	3,512	66	617	381	383	887	16,580
58	Lexington,KY	0	0	251	0	0	0	0	0	251
59	Huntington,WV	8,855	498	782	7	315	16	1,003	560	12,035
60	Charleston,WV	153	1,012	3,385	1	790	447	61	59	5,909
61	Morgantown,WV	2,530	23	98	0	0	3	46	0	2,701
62	Parkersburg,WV	3,356	869	1,415	0	523	207	52	446	6,869
63	Wheeling,WV	13,246	495	731	2	248	663	1,540	337	17,261
64	Youngstown,OH	381	58	84	12	180	176	511	37	1,439
66	Columbus,OH	0	224	140	0	658	160	74	1	1,257
67	Cincinnati,OH	26,314	1,827	2,023	8	1,711	778	1,109	1,655	35,424
80	Evansville,IN	15,990	1,789	5,519	424	1,309	1,328	475	479	27,314
83	Chicago,IL	1,513	54	82	4	100	28	116	202	2,100
85	Springfield,IL	0	0	0	0	10	0	0	0	10
86	Quincy,IL	104	0	2	0	5	0	0	0	110
87	Peoria,IL	584	13	15	2	24	0	113	7	758
89	Milwaukee,WI	3	0	0	0	0	0	2	0	5
91	La Crosse,WI	114	0	0	0	3	2	6	3	128
96	Minneapolis,MN	270	0	6	0	14	0	34	15	339
98	Dubuque,IA	328	0	0	0	3	0	0	2	332
99	Davenport,IA	1,231	0	0	22	20	0	0	5	1,278
105	Kansas City,MO	0	0	0	0	9	0	0	0	9
106	Columbia,MO	0	0	12	0	5	0	0	0	17
107	St Louis,MO	1,606	300	194	219	69	61	213	59	2,721
110	Fort Smith,AR	0	0	0	2	0	4	5	0	11
111	Little Rock,AR	0	0	146	76	18	0	62	21	324
112	Jackson,MS	0	14	230	22	5	3	1	12	288
113	New Orleans,LA	13,882	422	1,655	9,447	182	6	157	1,072	26,823
114	Baton Rouge,LA	327	21	1,172	791	44	35	35	617	3,041
115	Lafayette,LA	5	0	432	0	0	0	11	1	449
116	Lake Charles,LA	19	3	1,029	0	4	0	0	50	1,104
117	Shreveport,LA	0	0	728	0	17	0	0	25	770
118	Monroe,LA	59	0	341	3	1	2	2	7	415
121	Beaumont,TX	18	22	189	0	0	0	62	1	292
122	Houston,TX	7	143	73	7	435	7	246	128	1,045
130	Corpus Christi,TX	0	0	0	0	4	0	0	5	9
131	Brownsville,TX	0	15	0	4	1	5	25	6	57
138	Tulsa,OK	55	0	0	0	4	0	109	2	170
143	Omaha,NE	0	0	0	0	4	0	0	9	13
Total		158,641	14,828	39,448	14,992	10,717	6,562	9,651	12,145	266,984

* A Bureau of Economic Analysis (BEA) economic area consists of a standard metropolitan statistical area. (SMSA) serving as a center of economic activity and its surrounding counties.

Source: WCSC Data

navigable tributaries. For example, total traffic at L/D 52 on the lower Ohio is over four times greater than traffic at Emsworth, the uppermost Ohio River project; Winfield L/D at the mouth of the Kanawha River handles nearly three times more traffic than the uppermost lock at London; and L/D 1 on the Green handles twice as much traffic as L/D 2.

An historic tonnage series by project is displayed for the years 1984 through 1995 in Table 20. Annual growth rates in traffic at Ohio River projects during this period range from 1.2 percent at Emsworth L/D to 5.1 percent at Greenup L/D. Four of the five fastest growing projects over the past ten years (London, Marmet, Greenup, and R.C. Byrd) owe their growth to coal and the strong demand for low sulfur coals.

Project Performance

Project performance is a direct reflection of the productivity of an individual lock and the towing companies that use it. Some of the most common indicators of project performance are displayed in tables 21, 22, and 23. These indicators pertain to the number of tows processed, the number of lockage cuts per tow, barges per tow, and lockage times (processing and delay times). As such these indicators reflect conditions and characteristics of the plant and equipment operated by lock and vessel masters, as well as their proficiency in operating their equipment. These indicators are also a reflection of the adequacy of a project for meeting lockage service demands

In terms of equipment processed, locks along the lower Ohio River (L/D 53, L/D 52, Smithland L/D, Uniontown L/D, and Newburgh L/D) have consistently been the busiest. In 1995 L/D 52 was the busiest

handling 10,428 tows and over 99,000 barges, followed by Smithland with 7,972 tows and nearly 88,000 barges, Uniontown with 6,870 tows and over 78,000 barges and Newburgh with 6,812 tows and over 70,000 barges. LPMS data is not collected at L/D 53 (see Table 21).

These large-chambered locks are able to process as many as 15 barges in one lockage operation, or cut. Small-chambered locks, for the most part located on tributary streams, handle far fewer barges, but are busy in that they may perform many lockage operations each year. In terms of lockage cuts, Winfield and Marmet locks and dams were the busiest locks in the Ohio River System with 21,800 and 18,435 lockages, respectively. L/D 52 was the third busiest with 11,699 cuts. Eleven other Ohio River projects, five Monongahela projects, London L/D on the Kanawha River, and Kentucky Lock on the Tennessee River completed more than 5,000 lockage cuts in 1995.

Average cuts per tow is a good indicator of the adequacy of a project for handling modern towing equipment and vessel configurations for a given level of lock service demands. Older locks tend to have smaller chambers, requiring tows to break into smaller sections in order to be locked through. Locks on the Allegheny, Kanawha, Monongahela, and Tennessee rivers average from 1.8 to as many as 12.3 cuts per tow, multiple cuts which drive up lockages drive up lock processing times and tow operating costs.

The number of barges in the average tow - the average tow size - has been increasing through time. Increases in towboat horsepower and efficiency have enabled towing companies to increase the number of barges

that can be safely and economically navigated by a single towboat. Lock chamber sizes have also been increasing through time, allowing the use of ever-larger tows. All of the Ohio River locks, except the four uppermost projects, average ten or more barges per tow. On the tributaries where the lock chambers are smaller, the average tow size is smaller. Towing companies are keenly interested in tons per tow, a measure which provides them with a first indication of the productivity and profitability of operating on a given river segment. The average tonnage pushed in each tow relates not only to the indicator discussed above, barges per tow, but also to barge capacity and the percentage of total barges that are empty while moving on the waterways. Barge capacities have increased through time as towing companies phased-out smaller, 1000 ton capacity standard barges in favor of stumbo (1250 tons capacity), jumbo (1500 tons capacity), and the new super jumbo (2100 - 3300 tons capacity) barges. Further gains in average loadings may come from decreasing the percentage of time barges move with no load. A majority of the Ohio River Basin projects locked empty barges between 28 and 64 percent of the time, indicating barges generally are dedicated to a movement that offers the possibility of one-way carriage only.

All of these factors affect delay and lock processing time, which relate directly to the transportation costs borne by the carrier. In 1995, the uppermost locks on the Tennessee River (Chickamauga, Watts Bar, and Ft. Loudoun) had average processing times of 318.6, 297.8 and 178.3 minutes, respectively. These times reflect the very high lift of these three projects, causing long chamber filling and emptying times, and small lock chamber sizes, resulting in averages of 8 to 12 cuts per tow. Processing

times at the Kanawha River projects with their similarly sized lock chambers are all over 100 minutes. Heavy traffic demands placed on these small-sized Kanawha projects also lead to lengthy delays, an average of 167.1 minutes at Winfield and 108.5 minutes at Marmet. Only the delays experienced at undersized Kentucky L/D on the Tennessee River exceeded those at Marmet (see Table 22).

The number of tows has grown steadily over the past ten years at most Ohio River System projects, with the notable exception of some locks on the Monongahela, all locks on the Allegheny, all locks on the Green, and a few locks on the Tennessee (see Table 23).

As demonstrated in the discussion above, traffic growth, as measured by tow passages cannot by itself predict performance problems at individual locks. By comparing historic tow passages with historic delays, it can readily be seen that number of tows infrequently appears to correlate with delays. Delays at R.C. Byrd have declined, while number of tows has increased, owing to the construction of additional lock capacity. Delays may also rise while number of tows decline because of maintenance or rehabilitation closures. Nevertheless, a series of high delays is indicative of a need to take performance improving measures.

Table 19
1995 ORB Lock Traffic by Commodity
(Kilotons)

River/Project	Coal	Petrol	Aggs	Grains	Chem	Ore/ Min	Iron/ Steel	Other	Total
Ohio River									
Emsworth	16,908	1,432	2,022	99	756	600	772	486	23,075
Dashields	16,877	1,787	2,998	30	817	602	920	520	24,551
Montgomery	17,522	1,884	1,952	45	1,272	653	1,442	745	25,515
New Cumberland	26,037	2,297	1,280	90	1,835	1,193	2,569	1,444	36,745
Pike Island	30,289	2,579	1,418	99	1,947	1,179	4,046	1,752	43,309
Hannibal	29,756	2,194	1,462	86	1,872	1,519	3,620	2,274	42,783
Willow Island	29,740	2,445	1,989	122	2,022	1,631	4,012	2,573	44,534
Belleville	29,671	2,848	2,943	114	2,664	1,807	4,049	3,026	47,122
Racine	29,573	2,840	3,481	136	2,598	2,042	4,080	3,250	48,000
Robert C. Byrd	35,321	4,116	5,290	134	3,428	2,187	3,995	4,178	58,649
Greenup	41,301	4,887	5,431	147	4,254	2,165	3,847	5,541	67,573
Meldahl	37,771	4,710	5,386	262	4,056	2,307	4,010	4,874	63,376
Markland	26,551	3,394	5,030	2,741	5,389	2,971	4,841	6,840	57,757
Mc Alpine	26,166	3,030	3,718	3,662	5,723	3,319	5,562	6,429	57,609
Cannelton	26,753	2,725	4,806	3,577	5,936	3,155	5,229	7,332	59,513
Newburgh	35,693	3,375	4,673	4,700	6,331	4,106	5,214	7,960	72,052
Uniontown	42,052	4,298	1,631	7,891	7,186	4,525	5,631	8,894	82,108
Smithland	46,721	4,428	3,475	8,318	7,087	4,747	5,471	8,898	89,145
L/D 52	37,039	5,505	12,476	12,038	9,613	5,336	7,776	7,684	97,467
Kanawha River									
London	7,961	3	25	0	0	0	2	19	8,010
Marmet	14,894	380	547	0	207	88	5	53	16,174
Winfield	16,774	1,204	2,734	0	906	105	58	227	22,008
Monongahela River									
Opekiska	360	0	0	0	0	0	6	4	370
Hildebrand	329	0	0	0	0	0	25	3	357
Morgantown	380	30	174	0	0	29	9	8	630
Point Marion	6,782	52	243	0	1	31	22	115	7,246
L/D 7*	4014	28	260	0	0	30	9	19	4360
Grays Landing	8,402	47	346	1	1	33	20	33	8,883
Maxwell	11,775	82	287	0	8	36	15	64	12,267
L/D 4	12,417	138	545	0	25	43	16	115	13,299
L/D 3	12,380	529	606	1	148	96	336	320	14,416
L/D 2	14,948	750	793	28	306	490	559	358	18,232
Allegheny River									
L/D 8	0	0	570	0	0	0	0	9	579
L/D 7	0	0	15	2	14	18	24	25	98
L/D 6	32	0	21	0	20	5	9	26	113
L/D 5	33	0	23	1	21	15	11	28	132
L/D 4	53	126	319	12	48	50	89	31	728
L/D 3	1,316	160	492	13	123	65	78	35	2,282
L/D 2	1,242	178	463	16	127	53	130	31	2,240
Green River									
L/D 2	1,689	0	142	247	0	0	3	5	2,086
L/D 1	3,453	0	207	262	7	282	16	45	4,272
Cumberland River									
Old Hickory	0	8	225	0	205	2	3	19	462
Cheatham	128	102	2,460	13	385	98	865	1,133	5,184
Barkley	839	93	3,192	219	76	27	137	723	5,306
Tennessee River									
Ft Loudon	4	0	54	1	26	247	13	269	614
Watts Bar	7	45	91	476	100	313	82	328	1,442
Chickamauga	9	69	100	469	166	615	86	797	2,311
Nickajack	664	152	722	913	399	604	302	1,617	5,373
Guntersville	1,916	171	677	2,246	451	432	438	1,705	8,036
Wheeler	1,702	240	1,490	3,016	1,412	435	567	2,272	11,134
Wilson	1,676	216	1,422	3,076	1,606	441	532	2,410	11,379
Pickwick	5,797	241	1,351	3,157	1,500	476	774	2,104	15,400
Kentucky	13,663	269	9,216	3,646	2,035	612	1,556	2,731	33,728

Source: LPMS Data

*L/D 7 ceased operations July 30, 1995

Table 20
1984-1995 ORB Traffic by Project
(Kilotons)

River/Project	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	Average Annual Rate 1984-95
Ohio River													
Emsworth	20,268	17,246	17,649	20,449	19,812	19,274	23,068	20,420	23,391	23,901	24,272	23,075	1.2%
Dashields	21,207	17,912	18,623	21,742	21,071	20,271	24,025	21,712	24,659	24,961	25,602	24,551	1.3%
Montgomery	22,233	19,012	20,099	22,967	22,762	21,451	25,477	22,996	26,402	28,510	27,313	25,515	1.3%
New Cumberland	26,401	22,775	24,217	28,190	29,421	28,026	30,822	27,834	30,848	34,179	37,272	36,745	3.1%
Pike Island	32,517	27,312	29,737	33,992	34,519	34,138	35,841	32,443	35,175	38,339	43,643	43,309	2.6%
Hannibal	34,998	29,099	30,339	34,435	33,857	34,373	36,045	34,193	38,298	41,780	47,783	42,783	1.8%
Willow Island	35,968	29,974	29,998	31,232	33,553	33,606	33,921	32,528	36,202	40,511	45,802	44,534	2.0%
Belleville	38,634	32,376	31,848	33,379	35,847	35,500	37,044	37,394	43,324	43,295	48,641	47,122	1.8%
Racine	39,934	33,217	33,331	34,432	36,527	36,479	38,388	36,942	39,183	44,430	49,845	48,000	1.7%
Gallipolis	36,809	33,275	36,763	37,508	39,609	40,104	41,659	42,715	44,708	—	—	—	—
Robert C. Byrd	—	—	—	—	—	—	—	—	—	51,240	56,079	58,649	4.3%
Greenup	39,203	41,139	44,471	46,586	50,200	50,921	54,136	52,012	61,130	61,339	68,695	67,573	5.1%
Meldahl	41,021	42,265	46,087	46,049	48,387	46,943	53,095	58,024	58,349	61,303	64,627	63,376	4.0%
Markland	39,767	43,356	46,353	46,334	48,761	47,535	51,391	54,627	54,119	57,897	60,011	57,757	3.5%
McAlpine	43,834	49,538	53,591	53,920	54,951	56,264	56,709	60,420	57,653	62,076	61,943	57,609	2.5%
Cannelton	46,517	51,371	56,827	55,953	55,607	58,089	59,948	63,590	60,264	63,573	64,257	59,513	2.3%
Newburgh	50,035	56,526	60,808	61,063	61,081	66,433	71,877	75,767	70,790	73,966	76,779	72,052	3.4%
Uniontown	58,197	63,740	68,829	69,659	67,939	73,404	80,434	82,805	77,552	80,457	85,718	82,108	3.2%
Smithland	64,173	70,180	75,671	77,634	77,111	82,234	89,936	93,031	89,096	88,679	93,337	89,145	3.0%
L/D 52	73,496	79,091	84,355	87,283	83,468	91,891	99,164	103,461	95,120	94,540	101,267	97,467	2.6%
Kanawha River													
London	2,791	2,681	3,467	4,236	4,488	4,840	6,163	6,517	5,703	7,445	7,518	8,010	10.1%
Marmet	7,904	8,277	10,142	11,044	11,121	12,292	14,429	15,689	15,193	16,104	17,372	16,174	6.7%
Winfield	15,296	15,665	17,773	18,798	18,112	18,758	21,231	21,563	21,216	22,121	22,272	22,008	3.4%
Monongahela River													
Opekiska	66	211	321	730	789	723	571	565	616	487	548	370	17.0%
Hildebrand	316	781	1,033	1,734	1,250	1,117	636	656	610	494	571	357	1.1%
Morgantown	871	1,389	1,946	3,194	2,701	2,644	1,920	1,766	1,690	1,589	1,264	630	-2.9%
Point Marion	9,969	8,381	10,224	12,250	11,216	11,328	10,445	9,952	9,952	8,291	10,282	7,246	-2.9%
L/D 7 *	11,338	9,834	11,975	14,344	13,192	12,952	12,635	12,320	11,896	8,702	10,288	4,360	8.3%
Grays Landing	—	—	—	—	—	—	—	—	—	1,651	11,442	8,883	—
Maxwell	15,808	13,275	14,730	16,261	15,462	15,545	15,315	14,532	15,330	13,193	15,116	12,267	-2.3%
L/D 4	16,642	14,344	16,030	17,754	16,338	16,398	16,062	15,569	16,221	14,236	16,453	13,299	-2.0%
L/D 3	18,978	16,404	17,516	19,865	18,288	18,630	18,458	16,494	18,103	15,801	16,602	14,416	-2.5%
L/D 2	17,528	15,326	15,894	17,690	16,084	15,802	18,969	16,181	19,462	19,013	20,188	18,232	0.4%
Allegheny River													
L/D 9	0	0	0	0	0	17	30	0	0	0	0	0	N/A
L/D 8	458	586	422	1	451	563	517	534	18	256	516	579	2.2%
L/D 7	106	60	108	163	201	175	76	114	171	109	89	98	-0.7%
L/D 6	698	969	108	176	210	208	92	131	176	124	117	113	-15.3%
L/D 5	805	1,059	646	703	506	240	134	178	314	303	204	132	-15.2%
L/D 4	1,622	1,902	1,560	1,490	1,785	1,589	1,357	1,229	1,299	930	753	728	-7.0%
L/D 3	2,342	2,387	2,107	2,591	2,161	2,194	2,461	2,070	2,191	2,140	2,435	2,282	-0.2%
L/D 2	2,325	2,335	2,072	2,554	2,168	2,154	2,442	2,047	2,147	2,144	2,367	2,240	-0.3%
Green River													
L/D 2	7,413	6,912	5,568	6,278	4,204	3,275	5,411	4,704	3,604	2,501	3,631	2,086	-10.9%
L/D 1	10,518	10,418	8,562	10,159	7,698	7,961	10,288	9,871	8,218	6,885	5,712	4,272	-7.9%
Cumberland River													
Cordell Hull	96	165	7	0	0	0	0	0	0	0	0	0	—
Old Hickory	363	320	621	791	770	764	756	751	402	449	443	462	2.2%
Cheatham	3,376	4,067	4,395	4,895	4,684	4,580	4,586	4,574	4,421	5,306	5,367	5,184	4.0%
Barkley	2,000	2,300	12,800	5,000	4,900	3,700	2,985	2,118	5,261	4,553	4,365	5,306	9.3%
Tennessee River													
Ft Loudoun	580	567	533	588	625	532	604	423	418	483	631	614	0.5%
Melton Hill	0	2	1	0	0	0	0	0	0	0	0	0	—
Watts Bar	1,306	1,080	1,355	1,897	1,679	1,399	1,465	1,198	1,268	1,298	1,541	1,442	0.9%
Chickamauga	2,034	1,854	2,147	3,318	2,494	2,156	2,215	2,026	2,028	2,096	2,296	2,311	1.2%
Nickajack	6,257	5,995	6,096	5,352	5,198	4,723	5,154	4,498	4,295	4,734	5,342	5,373	-1.4%
Guntersville	6,886	6,400	7,238	5,677	5,867	6,387	7,383	6,785	7,824	8,108	8,331	8,036	1.4%
Wheeler	7,789	7,235	8,498	7,417	8,214	8,525	9,707	9,634	10,010	10,773	11,370	11,134	3.3%
Wilson	8,252	7,721	8,966	7,667	8,574	8,834	10,441	10,013	10,476	11,084	11,634	11,379	3.0%
Pickwick	16,753	16,824	19,087	17,850	21,635	18,976	18,388	18,432	19,103	19,258	18,416	15,400	-0.8%
Kentucky	26,700	25,600	21,100	30,100	32,400	29,600	28,880	29,224	30,823	33,708	33,427	33,728	2.1%

Source: LPMS Data.

*L/D 7 ceased operations July 30, 1995

Table 21
1995 Performance Characteristics of ORB Projects

River/Project	No. Tows	Number of Barges			Barges /Tow	Avg. Tons /Tow	Avg. Time*		Lock Cuts	Lock Cuts	
		Loaded	Empty	Total			/Tow (min.) Delay	Proc.		Cuts	/Tow
Ohio River											
Emsworth	5,235	18,265	12,149	30,414	5.8	4,408	56.1	59.3	9,704	1.9	23,075
Dashields	4,876	19,496	13,132	32,628	6.7	5,035	29.7	57.9	8,608	1.8	24,551
Montgomery	4,523	19,354	11,272	30,626	6.8	5,641	42.0	67.4	8,239	1.8	25,515
New Cumberland	4,773	26,379	18,561	44,940	9.4	7,699	19.1	55.5	6,267	1.3	36,745
Pike Island	5,086	31,170	20,740	51,910	10.2	8,515	16.3	50.3	6,574	1.3	43,309
Hannibal	3,823	31,137	12,501	43,638	11.4	11,191	13.6	51.9	4,357	1.1	42,783
Willow Island	4,062	32,007	15,829	47,836	11.8	10,964	16.9	51.6	4,990	1.2	44,534
Belleville	4,096	33,476	17,153	50,629	12.4	11,504	67.4	62.3	5,290	1.3	47,122
Racine	4,257	34,060	17,452	51,512	12.1	11,276	25.1	54.8	4,905	1.2	48,000
Robert C. Byrd	5,250	39,709	17,509	57,218	10.9	11,171	35.2	52.2	5,973	1.1	58,649
Greenup	6,313	43,633	25,752	69,385	11.0	10,704	45.0	51.7	7,396	1.2	67,573
Meldahl	5,547	40,491	23,320	63,811	11.5	11,425	37.9	54.5	7,491	1.4	63,376
Markland	5,012	37,282	16,080	53,362	10.6	11,524	45.5	56.5	6,277	1.3	57,757
McAlpine	4,748	37,112	12,667	49,779	10.5	12,133	55.8	59.5	5,528	1.2	57,609
Cannelton	5,133	39,082	15,170	54,252	10.6	11,594	37.5	57.7	5,998	1.2	59,513
Newburgh	6,812	47,427	23,026	70,453	10.3	10,577	23.0	46.6	8,284	1.2	72,052
Uniontown	6,870	51,769	26,480	78,249	11.4	11,952	63.8	50.2	8,849	1.3	82,108
Smithland	7,972	56,016	31,629	87,645	11.0	11,182	16.6	45.0	9,036	1.1	89,145
L/D 52	10,428	63,257	36,270	99,527	9.5	9,347	125.7	30.1	11,699	1.1	97,467
Kanawha River											
London	3,048	6,217	6,266	12,483	4.1	2,628	14.8	126.3	10,121	3.3	8,010
Marmet	4,359	12,148	11,294	23,442	5.4	3,710	108.5	179.8	18,435	4.2	16,174
Winfield	4,840	16,231	12,075	28,306	5.8	4,547	167.1	166.6	21,824	4.5	22,008
Monongahela River											
Opekiska	200	305	296	601	3.0	1,850	0.0	31.3	729	3.6	370
Hildebrand	201	301	296	597	3.0	1,776	3.4	31.6	563	2.8	357
Morgantown	374	518	520	1,038	2.8	1,684	0.9	29.6	1,196	3.2	630
Point Marion	2,853	6,844	6,143	12,987	4.6	2,540	8.6	34.3	3,693	1.3	7,246
L/D 7 *	1,999	3,949	3,781	7,730	3.9	2,200	1.6	15.8	2,836	1.4	4,360
Grays Landing	3,969	8,513	7,849	16,362	4.1	2,220	7.7	28.5	5,277	1.3	8,883
Maxwell	4,058	10,638	10,080	20,718	5.1	3,023	2.7	41.9	5,587	1.4	12,267
L/D 4	4,737	11,216	10,775	21,991	4.6	2,807	16.5	44.4	7,353	1.6	13,299
L/D 3	6,501	12,206	11,185	23,391	3.6	2,218	9.7	32.5	9,340	1.4	14,416
L/D 2	4,360	14,244	8,613	22,857	5.2	4,182	14.1	45.0	6,924	1.6	18,232
Allegheny River											
L/D 8	728	368	390	758	1.0	795	0.3	26.2	1,336	1.8	579
L/D 7	104	72	97	169	1.6	942	1.0	38.0	808	7.8	98
L/D 6	127	87	136	223	1.8	890	1.0	39.0	1,026	8.1	113
L/D 5	165	97	173	270	1.6	800	4.3	34.2	1,720	10.4	132
L/D 4	801	577	649	1,226	1.5	909	4.5	50.5	2,890	3.6	728
L/D 3	1,488	2,229	2,303	4,532	3.0	1,534	8.1	48.7	4,476	3.0	2,282
L/D 2	1,588	2,279	2,437	4,716	3.0	1,411	9.5	49.8	6,311	4.0	2,240
Green River											
L/D 2	823	1,390	1,168	2,558	3.1	2,535	1.0	22.7	959	1.2	2,086
L/D 1	1,616	2,837	2,605	5,442	3.4	2,644	1.1	22.0	2,328	1.4	4,272
Cumberland River											
Old Hickory	338	310	293	603	1.8	1,367	3.2	46.1	2,296	6.8	462
Cheatham	1,126	3,495	3,116	6,611	5.9	4,604	3.4	56.1	2,296	2.0	5,184
Barkley	1,252	3,618	6,424	10,042	8.0	4,238	17.1	77.9	2,632	2.1	5,306
Tennessee River											
Ft Loudoun	239	380	273	653	2.7	2,569	22.1	178.3	1,892	7.9	614
Watts Bar	261	979	581	1,560	6.0	5,525	38.3	297.8	2,987	11.4	1,442
Chickamauga	361	1,629	872	2,501	6.9	6,402	89.7	318.6	4,455	12.3	2,311
Nickajack	894	3,511	2,454	5,965	6.7	6,010	10.4	81.1	2,287	2.6	5,373
Guntersville	1,146	5,677	3,472	9,149	8.0	7,012	22.9	97.1	3,657	3.2	8,036
Wheeler	1,714	7,654	5,317	12,971	7.6	6,496	29.1	89.3	3,833	2.2	11,134
Wilson	1,777	7,873	5,540	13,413	7.5	6,403	45.3	99.8	3,656	2.1	11,379
Pickwick	2,034	10,619	8,680	19,299	9.5	7,571	20.4	84.5	3,900	1.9	15,400
Kentucky	3,510	22,526	14,639	37,165	10.6	9,609	247.0	115.5	6,521	1.9	33,728

* Total Transit Time is the sum of the Delay and Processing times.

Source: LPMS Data.

*L/D 7 ceased operations July 30, 1995

Table 22
Historic Average Lock Delays
(Minutes/Tow)

River/Project	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Ohio River											
Emsworth	20.3	17.8	19.8	22.4	24.4	35.0	32.5	45.0	40.4	180.1	56.1
Dashields	67.7	30.4	25.8	104.4	232.6	58.4	29.7	31.6	31.7	37.5	29.7
Montgomery	37.6	244.2	100.5	55.2	38.7	56.2	39.9	62.4	72.9	72.5	42.0
New Cumberland	11.2	9.3	8.9	9.3	10.1	12.0	11.3	10.7	13.0	18.5	19.1
Pike Island	10.2	12.9	8.9	56.9	10.6	12.4	10.6	11.1	14.3	18.5	16.3
Hannibal	11.3	11.8	11.9	13.2	12.9	16.8	11.8	13.2	14.2	18.4	13.6
Willow Island	10.1	9.4	9.7	11.3	12.3	12.3	10.7	11.5	13.5	21.0	16.9
Belleville	10.9	10.9	9.3	41.0	10.2	11.3	10.3	11.8	13.1	14.1	67.4
Racine	19.1	13.6	18.3	12.0	14.7	39.2	14.7	15.3	68.0	31.5	25.1
Gallipolis	198.8	665.2	291.0	309.4	230.4	307.2	253.5	196.8	—	—	—
Robert C. Byrd	—	—	—	—	—	—	—	—	54.9	59.2	35.2
Greenup	18.1	47.2	18.8	23.5	25.4	25.0	298.7	35.8	41.4	96.6	45.0
Meldahl	36.9	33.8	199.7	29.8	24.9	59.7	47.8	43.1	43.6	44.9	37.9
Markland	87.3	28.8	32.0	51.2	20.4	24.2	29.1	30.9	37.4	173.6	45.5
McAlpine	63.3	52.4	295.8	52.3	59.0	48.0	62.1	54.5	178.5	67.6	55.8
Cannelton	56.7	402.3	57.1	45.6	55.5	46.5	53.4	46.7	52.6	76.4	37.5
Newburgh	30.3	25.4	25.4	111.7	26.5	27.9	59.7	26.0	30.3	28.1	23.0
Uniontown	39.4	30.1	30.9	64.3	373.2	48.3	45.3	43.6	44.5	62.5	63.8
Smithland	14.4	8.3	6.1	7.2	14.6	18.8	8.5	19.4	19.2	18.2	16.6
L/D 52*	131.6	124.6	170.4	218.6	32.3	52.7	186.1	89.8	8.6	151.5	125.7
Kanawha River											
London	41.7	43.2	38.5	40.6	46.0	38.4	62.5	13.2	35.8	33.3	14.8
Marmet	26.4	56.5	34.8	49.0	83.1	136.4	181.7	160.2	156.2	370.2	108.5
Winfield	341.0	234.4	243.8	194.8	338.0	324.5	601.8	562.1	725.4	642.8	167.1
Monongahela River											
Opekiska	0.3	0.2	1.6	0.6	0.4	0.2	0.7	0.9	0.7	0.1	0.0
Hildebrand	1.6	0.9	0.5	0.4	0.8	0.8	9.1	11.1	17.7	3.8	3.4
Morgantown	0.3	0.5	1.7	0.9	2.2	1.6	1.2	2.9	1.7	1.1	0.9
Point Marion	22.0	18.3	20.5	22.1	23.9	23.5	21.0	21.6	17.8	9.9	8.6
L/D 7 *	29.9	31.1	38.7	38.0	44.3	43.8	30.3	28.6	20.0	31.4	1.6
Grays Landing	—	—	—	—	—	—	—	—	1.9	8.6	7.7
Maxwell	2.0	2.9	3.2	1.8	2.2	2.9	1.6	3.4	2.3	2.3	2.7
L/D 4	39.4	15.9	20.1	23.2	23.6	20.9	16.1	19.5	16.7	21.8	16.5
L/D 3	14.9	13.5	13.4	18.7	13.1	13.5	13.0	12.8	10.9	14.0	9.7
L/D 2	18.2	35.3	13.5	14.5	9.4	17.2	10.9	15.4	18.1	122.6	14.1
Allegheny River											
L/D 8	0.3	0.3	0.0	0.3	1.8	1.8	0.2	3.1	0.2	0.3	0.3
L/D 7	1.6	0.7	0.6	1.0	0.8	0.1	0.8	0.8	0.1	2.4	1.0
L/D 6	1.6	1.7	1.4	1.2	1.4	0.8	1.3	0.8	0.6	5.7	1.0
L/D 5	1.1	1.6	1.1	1.3	3.1	3.9	2.1	1.0	2.8	1.4	4.3
L/D 4	6.5	4.0	2.9	4.7	3.8	4.1	4.3	4.5	2.6	6.1	4.5
L/D 3	12.0	8.1	8.1	5.7	7.2	9.6	8.9	8.7	7.9	10.5	8.1
L/D 2	12.0	9.5	8.4	7.9	9.3	10.4	10.8	9.2	9.3	11.7	9.5
Green River											
L/D 2	2.5	2.4	2.2	1.1	0.6	0.8	0.6	0.4	1.2	0.6	1.0
L/D 1	2.2	2.3	2.8	2.1	1.5	2.1	2.0	2.0	1.3	0.8	1.1
Cumberland River											
Old Hickory	5.6	8.5	6.1	9.6	4.0	5.7	5.1	2.6	2.0	2.9	3.2
Cheatham	3.5	4.3	7.5	4.6	3.8	3.7	11.2	2.7	2.3	3.2	3.4
Barkley	6.8	211.1	12.5	15.2	10.3	12.0	11.4	81.4	13.9	13.6	17.1
Tennessee River											
Fort Loudoun	8.0	12.8	18.4	18.0	14.0	20.8	13.5	13.5	15.8	24.1	22.1
Watts Bar	26.0	27.0	38.7	39.7	38.4	35.6	34.0	30.8	8.0	53.0	38.3
Chickamauga	60.0	69.1	106.2	74.9	67.6	65.0	50.1	51.0	53.9	79.5	89.7
Nickajack	9.2	11.7	11.9	10.5	10.1	11.9	9.9	12.0	11.8	10.1	10.4
Guntersville	16.4	19.7	14.6	16.6	62.9	28.0	15.5	25.0	24.3	60.3	22.9
Wheeler	33.4	22.8	18.5	25.9	22.9	25.4	21.3	67.0	31.7	33.8	29.1
Wilson	36.5	33.6	28.6	29.7	38.2	37.4	143.5	42.2	44.3	57.5	45.3
Pickwick	77.5	65.9	103.3	78.7	44.6	47.3	34.9	24.3	28.8	35.3	20.4
Kentucky	167.7	216.2	252.9	247.2	177.3	184.6	146.7	222.3	223.1	286.3	247.0

* Averaged over all tows using the facility, including those using the navigable pass.

The average delay during locking periods alone is considerably greater.

Source: LPMS Data.

*L/D 7 ceased operations July 30, 1995

Table 23
Historic Number of Tows

River/Project	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	Av. Ann. Growth Rate (1985-95)
Ohio River												
Emsworth	5,076	5,173	5,235	5,130	5,031	5,696	5,120	5,407	5,601	5,268	5,235	0%
Dashields	4,639	4,617	4,549	4,735	4,437	4,792	4,714	4,857	4,872	4,994	4,876	0%
Montgomery	4,247	4,534	4,408	4,624	4,496	4,790	4,520	4,783	4,897	4,831	4,523	1%
New Cumberland	3,660	3,983	4,276	4,629	4,333	4,331	4,037	4,257	4,579	4,923	4,773	2%
Pike Island	3,709	4,048	4,191	4,611	4,683	4,553	4,245	4,419	4,556	5,243	5,086	3%
Hannibal	3,140	3,096	3,258	3,548	3,365	3,407	3,269	3,617	3,860	4,216	3,823	2%
Willow Island	3,351	3,284	3,378	3,420	3,416	3,434	3,192	3,490	3,708	4,060	4,062	2%
Belleville	3,252	3,055	3,314	3,512	3,374	3,502	3,311	3,598	3,871	4,140	4,096	2%
Racine	3,481	3,451	3,598	3,661	3,596	3,802	3,552	3,634	4,027	4,395	4,257	2%
Gallipolis	3,680	3,837	4,210	4,278	4,329	4,456	4,537	4,588	—	—	—	—
Robert C. Byrd	—	—	—	—	—	—	—	—	4,687	5,164	5,250	3%
Greenup	4,867	5,271	5,302	5,660	5,538	5,799	5,305	5,930	5,793	6,437	6,313	2%
Meldahl	4,313	4,590	4,486	4,717	4,474	4,905	5,372	5,367	5,423	5,656	5,547	2%
Markland	4,299	4,695	4,705	4,930	4,626	6,181	5,087	5,135	5,063	5,089	5,012	1%
McAlpine	4,861	5,358	5,308	5,467	5,609	6,920	5,599	5,330	5,090	4,976	4,748	0%
Cannelton	4,858	5,318	5,173	5,271	5,436	6,860	5,673	5,471	5,142	5,206	5,133	1%
Newburgh	6,034	6,452	6,576	6,512	7,280	9,722	7,763	7,075	6,925	6,871	6,812	1%
Uniontown	6,259	6,884	6,829	6,622	7,131	9,765	7,765	7,231	6,845	7,070	6,870	1%
Smithland	7,150	7,532	7,781	7,834	8,383	11,339	9,183	8,762	8,278	8,252	7,972	1%
L/D 52	8,807	9,097	9,714	9,622	10,466	14,047	11,361	10,276	10,113	10,621	10,428	2%
Kanawha River												
London	1,324	1,628	2,036	1,995	2,161	2,438	2,536	2,317	2,902	3,010	3,048	8%
Marmet	2,866	3,279	3,546	3,486	3,836	4,163	4,449	4,239	4,371	4,712	4,359	4%
Winfield	3,912	4,406	4,617	4,500	4,749	4,999	5,272	4,996	5,016	5,119	4,840	2%
Monongahela River												
Opekiska	155	205	381	400	350	268	268	270	224	293	200	2%
Hildebrand	384	433	689	590	578	311	312	270	227	314	201	-6%
Morgantown	670	935	1,371	1,334	1,392	1,130	1,036	918	913	740	374	-5%
Point Marion	3,586	3,955	4,476	4,598	4,721	4,590	4,431	4,562	4,247	4,855	2,853	-2%
L/D 7 *	4,111	4,529	5,078	5,244	5,192	5,172	5,029	5,147	4,217	4,811	1,999	-7%
Grays Landing	—	—	—	—	—	—	—	—	765	5,151	3,969	NA
Maxwell	4,424	4,649	4,601	4,883	5,024	5,085	4,391	4,505	4,126	4,787	4,058	-1%
L/D 4	5,003	5,251	5,179	5,300	5,531	5,605	5,117	5,280	4,974	5,705	4,737	0%
L/D 3	6,766	7,056	7,534	7,427	7,457	7,632	6,857	7,575	6,847	7,148	6,501	0%
L/D 2	4,659	4,687	4,690	4,533	4,220	4,793	4,580	4,501	4,444	4,521	4,360	-1%
Allegheny River												
L/D 8	741	532	11	558	794	684	681	13	327	652	728	0%
L/D 7	99	151	221	403	319	114	145	164	121	88	104	0%
L/D 6	1,224	164	257	315	330	132	161	202	144	137	127	-19%
L/D 5	1,254	862	859	739	438	220	211	390	388	216	165	-17%
L/D 4	1,821	1,591	1,502	2,004	1,959	1,527	1,215	1,352	980	783	801	-7%
L/D 3	1,877	1,692	1,869	1,744	1,740	1,879	1,628	1,569	1,503	1,555	1,488	-2%
L/D 2	1,870	1,732	1,887	1,827	1,761	1,926	1,692	1,581	1,598	1,592	1,588	-1%
Green River												
L/D 2	3,469	2,832	2,197	1,555	1,434	2,564	1,836	1,341	976	1,281	823	-12%
L/D 1	2,389	1,955	3,528	2,781	3,097	4,509	3,550	2,701	2,285	2,052	1,616	-3%
Cumberland River												
Old Hickory	233	391	451	479	440	445	392	281	311	301	338	3%
Cheatham	931	1,086	1,123	1,087	1,123	1,067	1,025	1,024	1,105	1,148	1,126	2%
Barkley	625	2,209	1,313	1,277	1,008	711	804	1,272	1,156	1,142	1,252	7%
Tennessee River												
Ft Loudoun	241	243	256	245	206	191	157	160	194	237	239	0%
Watts Bar	327	378	385	379	313	286	238	231	265	278	261	-2%
Chickamauga	495	529	725	510	430	384	355	357	371	382	361	-3%
Nickajack	1,232	1,340	1,141	1,038	1,001	984	901	827	903	895	894	-3%
Guntersville	1,081	1,253	994	997	993	1,105	957	1,018	1,203	1,198	1,146	1%
Wheeler	1,043	1,172	1,027	1,186	1,267	1,365	1,350	1,360	1,628	1,627	1,714	5%
Wilson	1,180	1,312	1,192	1,383	1,398	1,495	1,400	1,400	1,705	1,709	1,777	4%
Pickwick	2,217	2,529	2,400	2,731	2,541	2,505	2,421	2,434	2,526	2,315	2,034	-1%
Kentucky	3,390	2,666	3,653	3,877	3,731	3,872	3,557	3,534	3,937	3,556	3,510	0%

Source: LPMS Data.

*L/D 7 ceased operations July 30, 1995

Recreational Traffic

The multi-purpose nature of the navigation projects on the Ohio River System has created new recreation opportunities on project lands and adjacent water surface areas. By themselves, the Ohio River mainstem navigation pools provide a 981 mile long string of continuous recreation lakes with nearly stable summer navigation pools and extensive shorelines for recreational development. These Corps projects and facilities attract thousands of visitors every year.

Most navigation projects in the basin process small recreational craft in addition to commercial traffic. Allegheny L/D 2 was the busiest recreation lock in the basin, with Chickamauga on the Tennessee and Emsworth on the Ohio a distant second and third (see Table 24).

Recreational craft have access to most public facilities developed for commercial towing, but generally prefer to use facilities developed specifically for them. These facilities include boat launching ramps, landings, and small boat harbors. They are generally located near population centers with convenient access to the pools formed by the navigation dams and are situated off the commercial navigation channels in coves and embayments or along smaller waterways that are not commercially navigable. Those situated along commercial waterways are frequently enhanced with facilities to serve a wide variety of recreation needs. There are over 750 such public and private pleasure craft facilities situated along the basin's waterways.

Table 24
Historic Ohio River System
Recreational Traffic

River/Project	1990	1991	1992	1993	1994	1995
Ohio River						
Emsworth	4,099	6,140	3,976	4,588	3,804	4,250
Dashields	2,290	3,572	2,706	3,216	2,828	2,958
Montgomery	1,923	3,200	1,990	2,599	2,388	2,532
New Cumberland	1,393	2,152	1,584	1,904	1,910	2,377
Pike Island	1,061	1,615	1,341	1,602	1,702	1,612
Hannibal	641	1,014	887	1,033	1,034	801
Willow Island	1,305	1,862	1,579	1,481	1,639	1,401
Belleville	1,116	1,608	1,410	1,650	1,362	1,324
Racine	872	1,784	624	1,169	912	853
Gallipolis	422	551	441	—	—	—
Robert C. Byrd	—	—	—	831	787	778
Greenup	529	601	720	507	395	1,009
Meldahl	3,994	5,025	3,432	4,748	5,194	3,984
Markland	1,457	5,873	4,281	4,729	3,005	3,214
McAlpine	1,293	1,260	984	1,086	1,081	924
Cannelton	1,101	999	838	999	1,013	971
Newburgh	2,401	2,651	1,898	2,422	2,654	1,943
Uniontown	1,994	3,768	2,724	2,292	2,740	2,293
Smithland	1,329	1,864	1,779	1,324	1,452	1,238
L/D 52	643	808	795	347	1,354	571
Kanawha River						
London	168	152	162	360	379	329
Marmet	318	311	533	537	381	711
Winfield	564	579	437	498	420	470
Monongahela River						
Opekiska	424	362	610	720	598	495
Hildebrand	229	218	202	253	247	298
Morgantown	430	553	498	658	576	656
Point Marion	238	243	213	267	287	420
L/D 7 *	368	509	383	690	401	880
Grays Landing	—	—	—	12	53	1,042
Maxwell	2,732	3,578	2,661	2,019	2,772	2,612
L/D 4	1,939	2,470	1,980	2,174	1,916	1,941
L/D 3	2,160	3,241	2,686	2,823	2,446	2,065
L/D 2	3,224	5,008	3,860	3,446	2,547	3,344
Allegheny River						
L/D 8	1,068	1,292	485	1,039	945	1,004
L/D 7	1,083	1,221	784	1,213	972	952
L/D 6	1,144	1,287	842	1,551	1,283	1,136
L/D 5	2,603	1,906	1,809	2,803	2,265	2,375
L/D 4	3,623	4,681	3,402	4,942	3,584	3,455
L/D 3	3,539	4,905	3,480	4,336	3,958	2,772
L/D 2	7,784	10,926	8,085	9,409	8,569	9,416
Green River						
L/D 2	479	524	66	100	132	111
L/D 1	1,873	1,864	1,184	1,425	1,348	734
Cumberland River						
Old Hickory	2,915	2,640	2,413	2,483	2,886	3,128
Cheatham	1,450	1,254	1,344	1,435	1,427	1,494
Barkley	1,046	2,081	1,822	1,419	1,753	1,752
Tennessee River						
Fort Loudoun	1,800	1,558	1,904	1,950	1,983	2,055
Watts Bar	2,030	1,582	2,202	2,292	2,251	2,548
Chickamauga	5,952	4,096	4,956	4,476	4,656	4,490
Nickajack	1,836	1,737	1,779	2,136	2,002	1,861
Guntersville	4,724	4,962	4,442	4,712	3,951	3,895
Wheeler	2,182	1,928	2,352	1,958	2,086	2,108
Wilson	2,039	1,685	1,979	2,025	1,655	1,620
Pickwick	1,644	1,566	1,683	1,617	1,755	1,657
Kentucky	1,012	645	742	662	689	650

Source: LPMS Data.

*L/D 7 ceased operations July 30, 1995

PART 6

1994 State and Port Commerce

State-to-State

Kentucky shippers used the Ohio River System (ORS) more than any other state in 1994. Approximately 92.3 million tons of commerce was moved on the ORS by Kentucky: 54.7 million tons were shipped to other waterside states, 21.3 million tons were received from other states, and 16.1 million tons of this commerce originated at and was destined for Kentucky docks. Kentucky, the nation's number three coal producing state, ships 43.6 million tons of coal by water (see Table 27). Many of the Kentucky industries that rely on the ORS waterways for the movement of goods operate their own waterside facilities for handling bulk commodities. There are over 50 coal loading facilities on Kentucky waterways, major petroleum shipping and receiving terminals, and over 40 non-coal, dry bulk handling facilities which transfer commodities such as aggregates, grain and ores.

Second largest in terms of tonnage shipped and received, West Virginia shippers moved 75 million tons on the waterways in 1994. Shipments totalled 50.1 million tons, receipts 13.1 million tons, and intra-state moves 11.8 million tons. Coal, long a dominant factor in the state's economy, accounted for 88 percent of West Virginia traffic. Over one-fourth of the state's total coal output moves by water to the nation's electric utility, steel, and export markets.

Ohio ranks third among states that use ORS waterways. In 1994, 59.3 million tons of commerce moved to or from inland docks in the state of Ohio. Shipments totalled 15.0 million tons, receipts 33.8 million tons, and intra-

state moves 10.5 million tons. Coal traffic accounted for 35 percent of total Ohio tonnage. The state's Ohio River docks are dispersed along 450 miles of the Ohio River, which forms the state's southern boundary. Ohio's electric utilities, coal producers and steel mills are the largest users of the inland waterway system.

Pennsylvania was the fourth largest user of the ORS in 1994. This state's waterborne activity, 48.2 million tons in 1994, is concentrated in the Pittsburgh vicinity where the Allegheny and Monongahela rivers meet to form the Ohio River. Pennsylvania shipments totalled 8.0 million tons, receipts were 28.3 million tons, and intra-state commerce was 11.9 million tons. Of total state ORS waterborne commerce, 34 percent was coal traffic.

Indiana docks shipped and received 44.8 million tons in 1994. Aggregates shipped from Indiana quarries and received at major sand, gravel, and stone terminals accounted for 19 percent of Indiana's ORS waterborne traffic.

Several other states are major users of the ORS. Illinois relies on the ORS to ship coal, aggregates and grain; Tennessee relies on the waterways for receipts of coal for its coal-fired electric utility plants, steel and stone for construction, grains for processing plants and feed mills, and raw materials for paper mills and chemical plants. Electric utilities are the predominant Alabama waterway users.

State-to-state movements of 1994 ORS traffic are summarized in Tables 25-27. Table 25 displays interstate as well as intrastate traffic, while Tables 26 and 27 show state distributions of shipments and receipts by commodity group. Ohio River Basin commerce statistics are available for eight ports as shown in Tables 28 and 29. The first shows

Table 25
1994 Ohio River System State to State Tonnage
(Million Tons)
Shipping State

Receiving State	WV	KY	PA	OH	IL	IN	AL	TN	Other	Total	%Change 1992-1994
West Virginia	11.8	1.9	1.9	2.9	1.0	2.2	0.0	0.0	3.2	24.9	0.07
Kentucky	6.1	16.1	1.0	1.6	1.0	4.4	0.0	0.2	7.0	37.4	0.06
Pennsylvania	17.5	1.3	11.9	4.9	0.8	0.3	0.1	0.0	3.4	40.2	0.01
Ohio	13.0	8.7	1.6	10.5	0.7	2.0	0.2	0.0	7.6	44.3	0.03
Illinois	1.5	1.5	0.1	0.3	0.6	0.4	0.1	0.1	0.5	5.1	-0.04
Indiana	2.8	2.8	0.7	0.1	11.6	5.1	0.1	0.1	2.9	26.2	0.08
Alabama	3.2	6.8	0.2	0.4	1.8	0.5	0.7	0.8	2.1	16.5	0.01
Tennessee	0.5	15.1	0.6	0.4	2.2	0.2	0.7	2.6	3.5	25.8	0.05
Other	5.5	16.8	1.9	4.5	6.9	8.5	0.9	1.1	0.0	46.3	-0.07
Total	61.9	70.8	19.9	25.5	26.4	23.7	2.9	4.9	30.4	266.7	0.02

Source: WCSC Data.

Table 26
1994 ORB State Commodity Shipments
(Million Tons)
Shipping States*

Commodity	WV	KY	PA	OH	IL	IN	AL	TN	OTHER	Total
Coal & Coke	52.7	43.6	16.1	20.7	15.4	8.2	0.1	0.5	1.3	158.6
Petroleum Fuels	6.3	0.5	0.3	0.2	0.3	2.2	0.1	0.5	3.5	10.6
Aggregate	2.0	16.0	2.6	1.2	3.0	8.7	0.4	2.4	0.1	36.3
Grain	0.0	2.4	0.0	1.3	3.4	3.4	0.1	0.4	1.2	11.0
Chemicals	0.3	0.7	0.2	0.4	0.4	0.2	0.3	0.2	7.9	2.7
Ores & Minerals	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.2	6.1	0.4
Iron & Steel	0.4	0.5	0.5	0.8	0.3	0.3	0.2	0.4	6.3	3.4
Other	0.2	7.1	0.2	0.8	3.6	0.6	1.7	0.6	3.9	14.8
Total	61.9	70.8	19.9	25.5	26.4	23.7	2.9	5.2	30.3	236.3

*Includes intra-state movements.

Source: WCSC Data.

Table 27
1994 ORB State Commodity Receipts
(Million Tons)
Receiving State*

Commodity	WV	KY	PA	OH	IL	IN	AL	TN	Other	Total
Coal	13.8	18.6	29.7	31.0	3.0	18.3	10.4	11.4	22.4	158.6
Petroleum	1.6	5.9	1.6	1.7	0.3	1.6	0.2	0.4	0.7	14.2
Aggregate	5.9	6.1	4.8	2.4	0.4	3.7	0.8	7.0	5.4	36.5
Grain	0.0	0.3	0.0	0.0	0.2	0.2	2.6	0.9	7.9	12.1
Chemicals	1.3	2.0	0.9	2.9	0.3	0.9	0.8	0.8	0.9	10.8
Ores & Minerals	0.5	1.2	0.8	1.9	0.2	0.7	0.1	1.1	0.1	6.6
Iron & Steel	1.1	1.1	0.9	2.6	0.4	0.6	0.2	0.9	1.9	9.7
Other	0.7	2.2	1.6	1.9	0.4	0.2	1.2	3.3	7.0	18.5
Total	24.9	37.4	40.3	44.4	5.2	26.2	16.3	25.8	46.3	266.7

* Includes intrastate movements

Source: WCSC Data.

Table 28
1994 Commerce by Commodity at Principal Ohio River Ports
(Million Tons)

Commodity	Pittsburgh	Huntington	Cincinnati	Louisville	Mt. Vernon	Nashville	Chattanooga
Coal	25.0	19.3	3.7	1.3	3.7	0.0	0.0
Petroleum	2.0	6.0	1.1	3.4	2.7	0.0	0.1
Aggregates	4.1	0.2	1.6	2.2	0.0	1.6	1.1
Grain	0.1	0.0	1.8	0.3	1.4	0.0	0.4
Chemicals	1.1	0.0	1.6	0.5	0.9	0.1	0.2
Ores & Minerals	1.0	0.0	0.8	0.3	0.0	0.1	0.1
Iron & Steel	1.8	0.1	1.3	0.4	0.2	0.8	0.2
Other	2.4	0.1	1.3	0.9	0.3	1.1	0.5
Total	37.5	25.7	13.2	9.3	9.2	3.7	2.6
Percent Change from 1993	3%	13%	-3%	12%	8%	6%	4%

port statistics for 1994 by commodity for the five largest ports in the basin. The second table gives statistics by shipment and receipt for all eight ports. The Port of Pittsburgh comprises those docks located on the Ohio River from Pittsburg, PA to mile 40 (Pennsylvania/Ohio State line); the Allegheny River from Pittsburgh, PA to mile 72 (to head of project); and the Monongahela River from Pittsburgh, PA to mile 91 (to head of project). The Port of Nashville includes both banks of the Cumberland River between river miles 182 and 194.

The Port of Pittsburgh with 40.1 million tons, is the largest port on the ORS in terms of total tonnage. Table 28 shows an in-

crease in commerce in 1994 at all the principal ports except the port of Cincinnati.

Almost 40 percent of total ORS commerce involved these principal ports—Pittsburgh, Huntington, Cincinnati, Louisville, Mount Vernon, Nashville, and Chattanooga. The Port of Pittsburgh is the leading receiver of traffic among the principal ports, and Huntington is the leading shipper of traffic.

PART 7 Waterway Data Publications

Waterborne Commerce Statistics Center

The Waterborne Commerce Statistics Center (WCSC) publishes a five volume annual report entitled Waterborne Commerce of the United States. Part 2 of this series contains Ohio River Basin data. The five-volume set, or any part of that set, can be purchased from:

*District Engineer
US Army Engineer District
PO Box 60267
New Orleans, LA 70160*

Table 29
1994 Ohio River System Port Commerce
(Million Tons)

Port	Receipt	Shipment	Total*
Pittsburgh	32.6	7.5	40.1
Huntington	0.3	25.4	25.7
Cincinnati	10.9	2.3	13.2
Louisville	8.5	0.1	8.6
Mount Vernon	1.7	7.6	9.3
Nashville	3.6	0.3	3.9
Chattanooga	2.5	0.2	2.7

*Doesn't double count intra-port movements

Source: WCSC Data.

The WCSC annually updates a data file compiled from their national origin-destination commerce file. To maintain confidentiality of shipper information, waterborne commerce data is made public only in summary form or as statistical abstracts. A response to an individual request will include all data for the three most recent available years, summarized by reach and 15 commodity groups. This information is available on disk and in hard copy. These listings include:

- reach to reach combinations, sorted by origin river reach;
- reach to reach combinations, sorted by destination river reach; and
- commodity groups sorted by origin river reach.

For data requests or more information, call the Corps' WCSC Office in New Orleans at (504) 862-1470.

Navigation Condition Report

A computer bulletin board is maintained for ORB navigation users. This bulletin board is updated daily and provides information on gauge readings, weather and ice conditions, dam conditions, precipitation, tows waiting, tows locked and delay times for each lock in the basin. This service is free to the public and access can be obtained from the Corps' Louisville Office at (502) 582-5613.

Lock Performance Monitoring System Statistics

Lock specific statistics are available on those portions of the inland waterway system having locks. All of these statistics are based on tow related data collected from towboat operators during lockages and are maintained by the Corps' Navigation

Data Center (NDC) in a data base file known as the Lock Performance Monitoring System (LPMS).

The lock specific tonnage data contained in this file are based on different collection methodologies and data sources than those used for WCSC data base. Therefore similar data categories have slightly different values. It is not possible to obtain tonnages and ton-miles for river systems from this source. For these reasons, the WCSC records, which are usually a year behind the LPMS records, are used for river system statistics and the LPMS data are used for navigation project statistics.

The Navigation Data Center publishes a quarterly summary of lock statistics for use by waterway planners and shippers, which may be obtained free of charge from:

*US Army Corps of Engineers
Water Resources Support Center
Navigation Data Center
Casey Building
Ft. Belvoir, VA 22060
(703) 355 -3052*

The Water Resources Support Center will also respond to specific requests for more detailed file information subject to the Corps' confidentiality constraints. These reports are computer generated and are furnished at cost. Contact the NDC at the telephone number listed above for more information.

Dock Listings

A listing of dock facilities is published by the Port Facilities Branch, Water Resources Support Center, U.S. Army Corps of Engineers. The 72 separate reports in the Port Series cover the principal U.S. Coastal,

Great Lakes, and Inland ports. Their address follows:

*Water Resources Support Center
Port Facilities Branch
Casey Building
Fort Belvoir, VA 22060-5586
(703)355-2495*

Internet access to the above described data is available through a National Data Center (NDC) home page on the World Wide Web, located at:

<http://www.wrc-ndc.usace.army.mil>

Ohio River System Navigation Report, 1996

This report is prepared and published by the
ORD Navigation Planning Center. Copies of
the report can be obtained from this office.

Address your requests or comments to:

U.S. Army Corps of Engineers

Attn: CEORH-NC

502 8th St.

Huntington, WV 25701

Ofc: (304) 529-5635

Fax: (304) 529-5114